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MAHARASHTRA STATE GAZETTEERS



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BOTANY AND FLORA OF MAHARASHTRA

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BOTANY AND FLORA OF MAHARASHTRA

CHAPTER I

ENVIRONMENTAL SETTING AND ITS FACTORS

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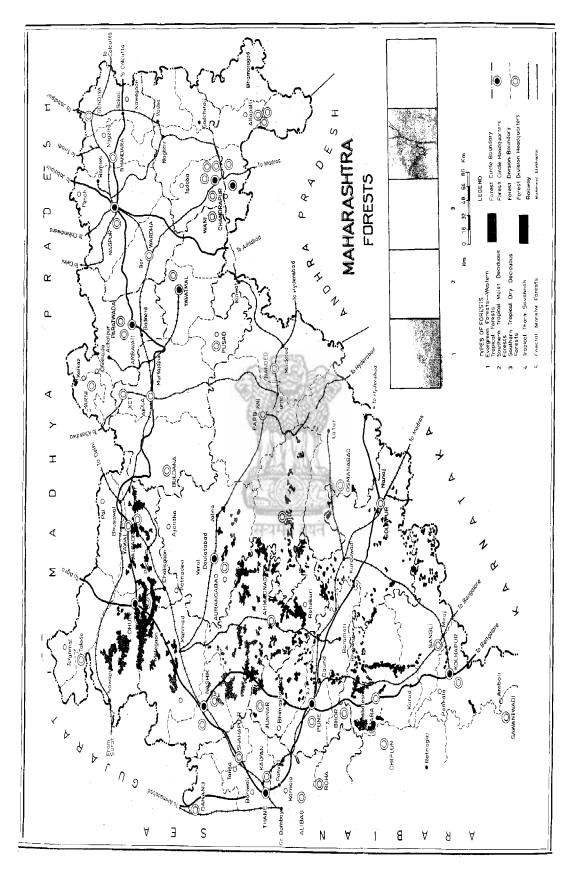
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PREFACE

I have every reason to be glad to present this unique volume entitled Botany and Flora of Maharashtra in the General State series of the Gazetteers of Maharashtra. This treatise has been written by the late Dr. T. S. Mahabale, an eminent Botanist of India, as a special assignment by the Gazetteers Department. The volume should have been published during his lifetime. Unfortunately, however, as Destiny had desired it otherwise, Dr. Mahabale completed his worldly sojourn just when he had completed his manuscript. And as Editor of the volume, I had to face an uneviable stupendous task of editing the manuscript on a highly scientific subject which I was ill-equipped to do. I, however, did it as a labour of love, and particularly with a sense of gratitude to the author and the tremendous importance of the subject. I must hasten to add that I am aware of my shortcomings. My job was made easier by Dr. J. G. Vaidya, Lecturer of Botany in the Poona University, who was assigned the work of scrutiny of the matter at the proof stage. I am sure Dr. Vaidya has done justice to this special assignment. I took another precaution by taking the help of Dr. V. S. Pradhan, Professor of Botany, Ruparel College, Bombay, for correcting the proofs at the second proof stage. It is gratifying to note that Dr. Pradhan undertook this laborious work with a friendly gesture at the instance of Shri A. T. Mahabale, son of the late Dr. T. S. Mahabale.

Actually this volume is the Fourth Part of the Maharashtra State Gazetteer on Botany. The earlier parts, namely, Part I—Medicinal Plants, published in 1953, Part II—Timbers, published in 1957, and Part III—Miscellaneous Plants, published in 1961, were all contributed by Dr. S. P. Agharkar, one of the most eminent Botanists of India who had a reputation for scholarship even abroad. In the nature of things, these books dealt with the botany of old Bombay Presidency excluding the Vidarbha and Marathwada regions of Maharashtra. Besides, Dr. Agharkar had adopted a different scheme of treatment and classification. We, therefore, decided to bring out a comprehensive volume with an entirely different scheme of treatment and emphasis. I believe this treatise gives a fairly comprehensive and systematic account of the botanical wealth of Maharashtra.

Studies on the plants of Western India date as far back as the third century A. D., the age of Nighantus. They mainly dealt with the medicinal plants, their properties and uses as source of drugs, compiled in the works as Nighantu. This tradition, however, went into oblivion during the dark days of science in India, and was revived only after the arrival of foreign invaders in India towards the beginning of the 16th century. The Portuguese, the Dutch, the French and the English, who came in succession, initiated botanical studies. A Portuguese physician. Garcia da Orta came to Goa by about 1534. He was a great scholar, physician and philanthropist. Much impressed by the earlier tradition of Ayurvedic medicine and Indian treatises on them, he wrote a book Os Colleguios er "Simple Drugs of India", and got it printed in Goa (1565). This book reached Europe through a Missionary by name El Clusius, and it caught the eye of many physicians, pharmacists and botanists of Europe to the plants of India. Hundred years later, came Heinrich Van Rheede tot Draakenstein, the Military Commander of the iv preface

forces of Dutch possessions in India and the Far East. He came to India in 1667 and became friendly with Indians. He secured the help of three Indian physicians to write on the Botany, properties and uses of plants in Malabar area in Western India. By this time, the methodical study of Botany in Europe had greatly advanced from the stage of Herbals to the stage of descriptive systematic Botany through the efforts of Germans. Their tradition of descriptive botany was brought to India by Van Rheede. He got his monumental work Hortus Indicus Malabaricus published at Amsterdam in 1678-1703. This first formal botanical description, with illustrations of the plants of Western India. It was followed by many botanists such as Graham 1837, Dalzell and Gibson 1851 and Nairne 1861. At the beginning of present century an excellent descriptive account of the plants in Bombay Presidency, was given in The Flora of the Bombay Presidency Theodore Cooke (1901-1908), who was Principal of the Science College at Pune for nearly 20—25 years. His work was incomplete, as the plants of Konkan were not given due consideration. His work was followed up by Blatter, Hallberg, McCann, Fernandes, Molliard, and many of their associates. Even then, there had been no comprehensive work on the Flora as such, like the Introductory Essay to the Flora Indica by Hooker and Thomson (1855) or the Sketch of the Flora of British India by Hooker (1904), in the Imperial Gazetteer Series. short account of the Botany of Bombay Presidency was given by W. D. Grey (1885). Volume XXV of the Gazetteer of Bombay Presidency was devoted to Botany, and was published in 1886. It contained three articles, namely,—

- (1) Useful Plants of the Bombay Presidency by J. C. Lisboa:
- Bota ny of the Bombay Presidency by Surgeon Major W. Grey; and
- (3) List of Gujarat Trees, compiled from materials supplied by G. H. D. Wilson and Lt.-Col. J. C. McRae.

After that there had been numerous publications on some families, individual genera, species, vegetation, etc. But there was no account of plants and flora as a whole on the lines of Hooker or Grey.

Since the above studies were totally out of date, the State Government decided to bring out the Gazetteer on Botany after establishment of the Gazetteers Office. The net outcome was the three books on Medicinal Plants, Timbers and Miscellaneous Plants, written by Dr. Agharkar. But as stated earlier, we decided to publish a more comprehensive and more systematic treatise on the botanical wealth of present Maharashtra. The present volume is a product of these efforts.

The information furnished in this volume is largely based on the works of previous authors who have worked on different groups of plants and on the vegetation of Maharashtra State till about 1980. The views expressed herein, however, are entirely those of the author, Dr. Mahabale. He makes no pretension to exhaustiveness of the study, although his work is unique.

A word about the nomenclature in this book is necessary here. As far as possible the author has not changed the names of plants as given by individual authors in their works, as that would have created confusion in the minds of readers. The corresponding name-changes can be found by interested readers in the works of Dr. H. Santapau, Dr. M. B. Raizada, or in Dr. Saldanha's Flora of Hassan District (1976), and others.

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The names of genera and species cited here are given with the original author's citation, and that is still considered to be valid. Hence this procedure.

A special attention has been paid to some new topics, such as fossil plants, plants of archaeological sites, fruit trees, and history of Botany and botanists in Maharashtra. Professional scientists and botanists in India and abroad will find this part of the study very useful.

Botany at present is a many-sided science. Several new disciplines are embodied in it. But no special efforts have been made to include all of them here. For example, physiological processes in plants, ecophysiology or cytoembryology have not been dealt with here. That was outside the scope of the present work.

A monumental work like the present Gazetteer requires not merely thorough research and knowledge of the subject, but also deligence and laborious work. It is remarkable that Dr. Mahabale, in spite of his age and ailing health, completed this treatise which has hardly any parallel in India. Born on 19 October 1909, he was the first to secure the Ph. D. Degree in Botany of the Bombay University. Besides four books, he published 134 research papers in well-known journals in India and abread. He held high positions in various Indian Universities, and in almost all Indian institutions and societies devoted to research in Botany and Flora. He has left the impress of his scholarship in many institutions, but more particularly in the Maharashtra Association for the Cultivation of Science, Pune, the Birbal Sahni Institute of Palacobotany, Lucknow, and the Indian Botanical Society. Unfortunately death laid his icy hands on him and snatched him away from us on 3 July 1983.

I owe my thanks to the Maharashtra Association for the Cultivation of Science, and particularly to Dr. G. B. Deodikar, Prof. K. R. Surange, Dr. V. D. Vartak, Dr. P. G. Patwardhan, Dr. V. G. Rao, Dr. A. V. Sathe and Dr. V. S. Rao for their kind and generous help to the author. I am specially indebted to the Director of the Botanical Survey of India, Pune, and to Dr. I. M. Qureishi, Chief Conservator of Forests, Maharashtra State, as also to Shri S. A. H. Qureishi and N. H. N. Shajkh of the Forest Department for authentic data, photographs and maps.

I must thank Dr. J. G. Vaidya for scrutiny of the proofs of this volume, which job was specially assigned to him. My thanks are also due to Dr. V. S. Pradhan, who undertook the laborious work of scrutiny of proofs at the second proof stage as a labour of love. The help of Shri A. T. Mahabale and Mrs. Mandakini Mahabale, wife of Dr. T. S. Mahabale, is a great debt which I owe to them.

The present members of the Editorial Board, reconstituted while the volume was under printing, have very kindly encouraged me in this work. To all these men of distinction, mentioned below, I am highly indebted:—

- (1) Additional Chief Secretary to the Government of Maharashtra Shri V. T. Chari (Chairman).
 - (2) Shri P. Setu Madhav Rao.
 - (3) Dr. C. D. Deshpande,
 - (4) Dr. U. M. Pathan,
 - (5) Shri D. B. Karnik.

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- (6) Prof. Y. S. Mahajan.
- (7) Dr. B. L. Bhole.
- (8) Shri S. G. Suradkar,
- (9) Dr. A. P. Jamkhedkar.
- (10) Dr. P. N. Chopra.
- (11) Executive Editor and Secretary (Shri K. K. Chaudhari).

I am thankful to Shri R. B. Alva, Director of Government Printing and Stationery; Shri G. D. Dhond, Deputy Director; Shri B. B. Bracken, Manager and Sarvashri B. P. Patil and R. B. Prabhudesai, Assistant Managers, Government Press, Nagpur, as also other officers, for the fine printing of this volume. My thanks are also due to Dr. V. N. Gurav, Deputy Editor; Sarvashri S. K. Khilare, P. N. Narkhede and B. M. Kausal (Research Officers); and Smt. M. S. Modikhane, Smt. N. S. Alwani, Sarvashri N. R. Patil, K. Z. Raut, D. J. Nawadkar, V. B. Sangrulkar, R. R. Hanwatkar, and V. J. Desai (Assistant Research Officers) for their assistance in the scrutiny of proofs of this volume. I must also thank Shri P. S. Khobrekar, Administrative Officer and other members of the staff for their association with this work.

I hope this cyclopaedic volume will be appreciated and found highly useful by scientists, and scholars in Botany as well as pharmacists and administrators who are interested not merely in the study of the Botany and Flora of Maharashtra, but also desiring to study the botanical wealth of India.

सत्यमेव जयत

Bombay:

17 February 1987.

K. K. CHAUDHARI,

Executive Editor and Secretary.

BOTANY AND FLORA OF MAHARASHTRA

CHAPTER 1: ENVIRONMENTAL FACTORS

1. BIRTH OF MAHARASHTRA STATE

On May 1st, 1960 the present State of Maharashtra was carved out of the then existing bilingual State of Bombay. It is a political entity extending from Bombay to Gadchiroli and Dhule to Sindhudurg districts. It is about 800 km. east-west and 700 km. north-south, an irregular dentate pentagon, lying between 22° 1′-16° 4′ north Latitude and 72° 6′-80° 9′ East Longitude, having an area of 3,07,762 sq. km. It is limited to the west by the Arabian Sea, making a long coastline of 720 km., by Goa and Karnatak to the south, by Andhra Pradesh on the southeast, by Madhya Pradesh on the north, and by Gujarat to its northwest. It forms a large part of Indian Peninsula.

Maharashtra as now formed comprises four regions: Vidarbha or the eastern Maharashtra, Desh or the central plateau of Deccan Peninsula lying to the east of Sahyadri, Marathwada and Konkan, a narrow coastal strip to the west of Sahyadris. There is some geographical diversity in these four regions, but there is also an in-built unity in them due to geographical location and common language of the people Marathi. The Bhakti cult exercised a great influence by its rich literature on the life and culture of the people for many centuries. Notwithstanding the changing political set-up or boundaries, the in-built unity among the Marathi speaking people has remained intact through centuries in various parts of the State and even beyond, as the Marathi speaking people are not confined to Maharashtra State only.

In a multilingual country like India, it is impossible to avoid overlapping of the people speaking different languages and having different ways of living, especially in the border areas.

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What is true of people, is much more true of plants. While studying their distribution, one comes across several instances of over-stepping the political boundaries by family after family of plants, by genera after genera and species after species. One soon comes to realise that the political concept of Maharashtra is not its bio-geographical or geobotanical concept. Therefore, while studying its plant life, one has to keep one's mind open and study carefully the procession of plant life through the ages in Maharashtra and the surrounding areas.

2. GEOGRAPHICAL SITUATION OF MAHARASHTRA

The geographical environment anywhere provides a stage for the life of people and at the same time puts limitations to their activities, aspirations and history. Plants are more dependant on it due to "Fixity of life" which is an overwhelming fact of plant life. Like animals they cannot move from place to place and have necessarily to adjust themselves to their geographical environment and therefore, to get an altruistic picture of plant life in any region, one has to have a good understanding of the environmental factors governing the region.

Maharashtra is essentially a part of Western India. It has a coast-line of about 720 km. from Daman to Terekhol Creek. It is only a part of much extensive coast line beginning with Sind, passing through Kutch, Saurashtra, Gujarat, Maharashtra, Goa, Mysore, Malabar or Kerala ending in Tamil Nadu. A rugged line of mountains runs in the north parallel to it and is formed by the outpourings of lava flows from volcanoes active some 70 million years back. Sahyadri is the northern part of the Western Ghats. They extend down south to Muliangiri in Karnatak.

3. Sahyadri Mountains and Passes through them

Sahyadris are flat-topped mountains having a varying height 20— 2000 m. above the sea level from Parner fort on Daman-Ganga to Baba Budhan Hills in Mysore through Sawantwadi and Goa. They run north-south and are about 750 km. in Maharashtra. They separate the Desh from narrow coastal strips of Konkan, 50-80 km. broad. It is the widest, about 75-80 km. in Ulhas-Vaitarna valley in Bombay region. There is lush green vegetation in Konkan all round the year due to maritime climate and high humidity throughout the year. But the tops of hills in many places are denuded and without any soil. The extremely rocky regions like Deogad in Konkan look barren in dry Desh looks green during and after the monsoons, but gets parched after December-January. The high wall of Sahyadris serves as a barrier for the migration of species on either side. The mountain passes locally called Ghat or Bari, are useful for traffic, trade and commerce. They are the routes for going from Desh to Konkan and Some of these passes are very long, e.g., Bor ghat between vice-versa. Bombay and Pune, Kasara ghat between Bombay and Nasik, Pasarni ghat between Wai and Mahabaleshwar, Phonda ghat between Kolhapur and Goa, Varandha ghat between Bhor and Mahad, Fitzgerald ghat between Mahabaleshwar and Mahad, Amba ghat between Kolhapur and Ratnagiri, and Amboli ghat between Kolhapur, Ajra and Sawantwadi and South Konkan, Malshej ghat between Junnar and Bombay, Melghat in Amravati district overlooked by Gavilgad and Chikaldara etc. One pass crosses the Narmada and enters Madhya Pradesh on way to Indore etc. These ghats are generally very narrow zigzag routes or paths with a scarp or canyon on one side and a valley on the other. They open huge vistas of scenery. Waterfalls, rivulets. rivers and cultivated fields are noticeable from them as they wind their way through mountainous territory. Several metres below underground strata there are reservoirs of water noticeable here and there. Precipitation in the ghat sections and on mountain tops is always heavy. Dense vegetation develops in the valleys. Thickets of stunted trees and bushes grow on mountain tops. In some places near a source of a river or a waterfall, caves are carved out in the brittle multi-layered strata of traps. In some inaccessible corner a small shrine of Shiva peeps out through the forest canopy, or on an isolated odd peak a Bhavani temple raises its head through it with Bhagwa flag hoisted on a pole. It is from such places in the ghats that one gets a panoramic view of the vegetation of Maharashtra, especially after the monsoons.

4. RIVER VALLEY SYSTEMS AND SAHYADRI MOUNTAIN RANGES

The Desh part of Maharashtra is divided naturally into six river valley systems of Narmada, Tapi, Purna, Wardha, Vainganga, Godavari, Bhima and Krishna. The three latter are more or less parallel to ranges of Sahyadri mountains on Desh side. They run from west to east diagonally forming four compartments of Maharashtra. Narmada

starting from Amarkantaka in Madhya Pradesh, flows through a very small northern part of our State, enters through Navapur, the alluvial plains of Gujarat and joins Arabian Sea at Broach. The river Vainganga starts from the Satpudas in Madhya Pradesh and flows straight in a southerly direction and then turns east to join the river Godavari at Sironcha. A little earlier the Godavari is joined by the Wardha and the Pranahita. The valley of the Tapi lies on the northern border of Maharashtra. It starts from Multai in Madhya Pradesh and is delimited at south by the Satmala and Ajantha ranges. They constitute uniform system of the Tapi lying to the north of Maharashtra. The Satmala range starts from Saptashringi hills and extends towards Daulatabad, Aurangabad and Manmad. There is a gap in these ranges between Daulatabad, Manmad and Ajantha ranges. This gap has played havoc in the history of Maharashtra, as the Muslim invaders from the north came into Maharashtra through it and thence spread further south. This is the Ajantha-Daulatabad-Ankai gap. kingdom of the Yadavas of Deogiri (Daulatabad) was destroyed by Allauddin Khilji coming through this gap.

Below this comes the second important range of mountains known as the Balaghat Range. It starts from Harishchandragad in Akola taluka of Ahmednagar district and extends upto Gulburga through Bidar and Osmanabad.

The valley of the Godavari river lies between Satmala-Ajantha range and Balaghat mountain range. The Godavari starts at Tryambak near Nasik and passes to Nasik, Kopargaon, Puntamba in Ahmednagar district and flows further via Gangakhed, and Nanded in Marathwada and thence into Andhra Pradesh. It is joined by the Pravara at Toka and by the Wardha and the Pranahita rivers near Sironcha, and that is the boundary between Maharashtra and Andhra Pradesh.

The third mountain range running west-east is known as Shambhu Mahadev mountains. They extend further into Karnatak. The river Krishna arises from the main Sahyadri mountain range at Mahabaleshwar. It is joined by five tributaries also arising in the same range of Sahyadris and passes through Anantpur district in Andhra Pradesh towards Vishakhapattam to join the Bay of Bengal.

An important river running parallel to Krishna is Bhima. It arises at Bhimashankar near Pune and flows through Daund, Pandharpur area and joins Krishna.

The last important river in Maharashtra is the Ghatprabha arising at Amboli in Maharashtra but flows very little in this State and passes into Karnatak territory.

It was observed earlier that the altitude of the Sahyadri ranges becomes less and less as they proceed towards east on the Desh side. The Desh plateau rises by stages from 335—366 metres, 366—610 metres at different places but the major part of Maharashtra is only 91—183 metres high on the Desh side. The highest peaks of the Sahyadris lie near its main axis forming watershed between Desh and Konkan. The altitude drops suddenly to 122 metres on Konkan side and thence almost to sea level. It does not come down by stages as on Desh side but suddenly. Correspondingly rainfall drops abruptly. On the Konkan side rainfall is heavy as the high escarpments of Sahyadris block it. The rivers in Konkan consequently flow very swiftly washing all the soil into sea. They are not extensive nor broad. They get flooded in rainy season and dry up afterwards. Starting from the north of Konkan, one notices rivers Damanganga, Tansa, Vaitarna and Ulhas. These are the larger rivers in Raigad and Thane districts. They provide

main water supply to Bombay city. Damanganga joins the Arabian Sca in Gujarat and is a natural boundary between Maharashtra and Gujarat States.

The next is a group of small rivers in Konkan the principal among them being Amba, Kundalika, Savitri, Shastri and Vasishthi in Thane district, Kajali, Muchkundi, Shuk and Gadnadi in Ratnagiri district. Below that the political boundary of Maharashtra ends with Terekhol river creek. Terekhol river is the boundary between Goa, Karnatak and Maharashtra.

All the Konkan rivers are shallow, flow fast through a narrow strip of the country made up of lateritic plateau having very little soil, with only the exposed rocks. There are no conspicuous dams, water reservoirs or lakes in Konkan as on the Desh side. Scarcity of water after February in summer months is usual in the rural areas of Konkan.

5. GHATS AND MAVALS

Two conspicuous features in the scenery of Sahyadris are the hill passes, known as ghats, and the hill forts built ... If along the line of Sahyadri in places not easily accessible. There are at least 20-30 major passes or ghats serving as the highways or bye-ways between Konkan and Desh. To reach a place in Konkan one has to cross more than one of them through a wooded mountainous country. Thus between Mahad and Pune there are several major passes such as Fitzgerald ghat, Varandha, Gonya, Ambenali, Tamane, Kumbharli, Katraj, and Diva ghats. Between Bombay and Pune there is the well-known Borghat. Other important ghats are Malshej, Chandwad, Thal ghat etc. As a matter of fact they are everywhere in the Sahyadris as one crosses from one side to the other. Between Pune and Goa there are Phonda, Amboli, Ramghat, Aner, Keljhar, Tina and Kudal ghats. Between Jalgaon and Surat there is Nandurbar ghat. These ghats or mountain passes are often quite narrow and lead from plains at lower altitude to higher mountain plateau and vice versa. They are generally in the weak sectors of mountains where the lava flows have been brittle and get easily disintegrated and washed away, than in harder core of the Deccan traps. Very often rivers, brooks, or small streams follow labyrithous path by their side and open into a low altitude basin of a river in the valley. Such valleys are well protected by two mountain spurs running parallel and are fed by mountain streams. They provide unique climate and locations for plants to grow isolated. called 'Maval' and are so many. A well-known Marathi poet has put "twelve such Mavals lie below Pune, and twelve below Junnar." They are well-protected uplands, well-drained valleys, well-watered by hill streams They are different from the surrounding areas. Their climate and flora They constitute botanical pockets of considerable inare different. terest being upland and isolated from each other and also from the rest of the country below. Hooker and Thomson (1839) have considered them as special sub-provinces or regions botanically and have stressed their importance. Their environment and flora are different. They are something like the Sholas in the Nilgiris in South India.

Valleys of Mavals below Junnar are called 'Nere'. The word is derived from the Persian word Nehar, Nehar meaning a tributary or a small river or a canal. Townships developed on them are named after them e.g. Sangamner, Junnar, Parner etc. The great diversity of geomorphological forms, varying from place to place in Sahyadri ranges, produce distinct climatic zones separated from each other by mountain barriers and have different vegetation.

High tops and spurs of the Sahyadris within a forthill also produce a somewhat similar situation in point of flora. Being at high altitude and separated by rocky scarps or artificially constructed fortwalls a similar situation is created.

Humidity in Maval valleys is conducive to the development of moist evergreen types, and to endemism, for example, Euphorbia acaulis grows only on the table land at Panchgani. The world famous endemic Frerea indica is confined to hill forts of Junnar and Purandar. Isoetes dixiti is found in the mountain turns at Panchgani, Panhala etc. Isolation of terrain by mountain ranges has led to endemism. Valleys on Konkan side encourage areca and coconut groves and other plantation crops due to nearness of sea, and high humidity throughout the year. Here the limiting factor is soil not humidity. Small valleys and creeks on the Konkan side produce good orchards and lush green vegetation due to high humidity throughout the year.

Strong hill forts on the peaks and spurs of Sahyadri have been known since the days of Kadambas. The principal among them are Sinhagad, Raigad, Pratapgad, Purandar, Panhala, Harishchandragad, Shivneri, Daulatabad, Songa, Aguada, Fonda etc. In the 15th and earlier centuries defence of the country depended upon the sturdiness of the hill forts. They really were the guardian sentinels of the freedom of Maharashtra since Bahamani rule. In the days of Shivaji, a great care was taken of them being of immense strategic use. Botanically very few of them have been explored, e.g. Purandar, Torna, Sinhagad by Santapau and Vartak. In their canyans and trenches, ledges and chinks often rare species have been preserved due to their inaccessibility; otherwise they would have disappeared. Many ferns, liverworts and mosses love to grow on fort walls.

A fourth peculiar habitat of plants in Maharashtra are the sacred groves of trees dedicated to gods, locally known as "Dev Raies". They contain trees and some important economic species. They constitute bits of select vegetation and are the conservatories of past types. Only a few of them have been studied by Gadgil, Vartak, Puri and Mahajan.

6. Two Prominent features in the Geomorphology of Maharashtra

Two prominent features in the geomorphology of Maharashtra are the Sahyadri mountain ranges, and the Arabian Sea coast. Some new facts about both these important features have recently been brought out by Koyna earthquake of 1967 and the International Indian Ocean Expedition of 1970. The greater part of Sahyadris lies in Maharashtra (Konkan) and is further extended upto Goa and Muliangiri in Baba Budhan Hills in Karnatak. They have no strike line being volcanic in origin, but only flat uplands along their north-south axis. It becomes somewhat bulged in the middle in Khandesh and runs north-south parallel to sea coast. It has varying width and broad plateaux at various heights. The top most of these receive highest rainfall as they constitute watershed e.g., Bhoma Hills near Khandala, Mahabaleshwar plateau, Tryambakeshwar Hills in Nasik district, Harishchandragad near Kalasubai in Ahmadnagar district. Muliangiri in Karnatak receives nearly 6858 mm. of rain, but it declines sharply eastwards and northwards. There are sharp variations in total rainfall from place to place. This is because the scarp wall of the Sahyadris lies directly in the way of SE monsoon clouds and obstructs them. Heavily water laiden clouds of SE monsoons pour their contents mostly on the high ranges and plateaus of Sahyadris and only depleted clouds pass over the ranges to Desh. The east side of Sahyadris the Desh thus lies in what they call 'Rain Shadow'. Similarly clouds when they pass northwards the rains become less and less.

But besides Arabian Sea clouds of SE monsoon, there is another route for the clouds, coming from Indian ocean over the Bay of Bengal. There are no hills or mountains in their passage and therefore the NE monsoon current over the Bay of Bengal is mostly uniform. But this current touches only a small eastern part of Maharashtra and hence does not affect most of the tableland or the Desh, as the SE monsoon.

SE monsoon is not uniform throughout the Desh, Madhya Pradesh and Gujarat; the altitude, local elevations of terrain etc., make difference in local temperature and humidity. Monsoons generally last from 7th June to 10th October. There are on an average 90-100 rainy days. In April and May the Indian continent gets heated up and low pressure zones begin to develop to its north. High pressure winds develop over cool Indian ocean and begin to flow over the heated Asiatic mass. Variable pressure zones are formed over the parts of Maharashtra, Madhya Pradesh and Gujarat. They gather strength by early June and monsoon bursts suddenly starting from Sri Lanka, Kerala and comes over coastal regions of Konkan and thence on the continent. The important features of SE monsoons are as follows:—

- (1) They burst suddenly in June and last for about 90-100 days till October 10. The rest of the year is dry, nearly for 8 months.
- (2) Humidity is very high 70-90 per cent during monsoons but in the dry period it is low varying from 10-30 per cent.
- (3) SE monsoons are not uniform throughout, but are pulsatory in action. It rains for some days and then there is break. Again it rains and stops again for a short while.
- (4) They fall at one place but not at another, so that there are comparatively alternate dry and short humid periods of about five days (pentads) everywhere during the monsoons. There is a short break or lull in August all over.
- (5) The uncertainty of quantity of precipitation and irregularity of monsoons is proverbial, because the precipitation depends upon the high pressure zones on Arabian Sea and the low pressure zones on the Indian sub-continent, velocity of winds, especially pre-monsoon, altitude, local heating of terrain, nearness to sea etc. The pre-monsoon and late monsoon winds coming from high seas act as trade winds and come over the Arabian Sea on West coast of India. This fact was known to Egyptians, Arabs, and Indian sea-farers and also to the Greek geographer Hippalus about 1,000 years ago before Vasco-da-Gama who is supposed to have found the sea route to India through Cape of Good Hope.

The direction of monsoons first is SW-NE, from June-October, and it gets reversed later NE-SW. They become then the return monsoons. But during their return journey their direction is not always the same as they get scattered and deflected all over Madhya Pradesh, Maharashtra, Gujarat, Uttar Pradesh, Telengana and Marathwada in late August and September. But in addition to SW monsoons there is another monsoon current that comes from the Bay of Bengal and flows over Tamil Nadu, coastal Andhra Pradesh, Orissa, Bengal, Assam, Meghalaya etc. At first it is a feeble current but as the SW current becomes weak, it becomes strong. In some places, the two intermingle.

These two cycles of monsoons are the basis of Kharif and Rabi seasons in India. By October, the Kharif growth season is nearly over and crops are ready for harvesting. In September and in October—November, second monsoon Rabi sowing is in full swing, because the weather in October gets cleared and is both humid and warm. In winter there are rains due to Bay of Bengal current. Thus depending upon rains, humidity and temperature we have two ripening seasons. One reaches a peak of flowering and fruiting in October and the other in March-April on account of the two monsoons' cycles. They have a significant role in the growth of plants and ripening of not only of crops, but of all plants wild and cultivate on Indian subcontinent.

Monsoons also have significant consequences on insect predators such as bees, butterflies and insects. During Kharif monsoon season, bees and butterflies feed on pollen of Kharif crops, but in Rabi season they feed on pollen of crops as well as wild plants. Rabi peak comes in March and lasts longer. Most of the Maharashtra regions especially the western, southern and central are under the influence of Kharif season, whereas Nagpur—Bhandara region is under the spell of NE current favouring Rabi seasons. Naturally crops like cotton, oil-seeds, pulses, shalu (winter jowar), wheat which need 120-150 days to ripen, grow better in these regions and early and short seasoned crops like jowar, bajri, nagli niger-seed do better in the Western Maharashtra.

The movement of winds helps the second season or winter monsoons. There are no Sahyadri or other mountains to cross or obstruct their movement. The precipitation is uniform and hence the crops are assured than those of Kharif.

In Rabi season, the humidity is high, and temperatures low and equable, more favourable for plant growth. At the same time, they are also favourable for the growth of plant diseases which naturally affect Rabi crops more than the Kharif ones. On the other hand, heavy rains in Kharif season, especially during anthesis period, are very critical for plant life. They adversely affect pollination, wash the pollen as in Bajri, and thereby prevent fertilization. It also makes way for the advent of plant diseases. Frosts are few. Low temperatures in Rabi season in January-February are highly conducive to the incidence of rust and smuts and for their growth and spread.

An important result of this double peaked growth of plants in two seasonal cycles results in the sudden appearance of the flora of Monsoon Ephemerals which constitutes a spectacular flora of the Peninsular India, in mountainous regions of Maharashtra and sandy areas of Telangana. Thus Sahyadris and Arabian Sea have profound and many fold effects on the entire plant life in Maharashtra.

As a general rule, nearness of sea, local variations and such other factors help to lower the temperature, and low rainfall and humidity tend to produce semi-desert conditions over the Desh region and plains, ultimately leading to scrubby type of vegetation. On the other hand where the rainfall is heavy as in Konkan plain, hilly uplands, Mavals or humid valleys, pockets of evergreen or semi-evergreen vegetations are formed. This process is further helped by the basaltic nature of the rocks of the Sahyadri having good water retaining capacity.

7. THE DECCAN TRAPS

They are the dark rocks seen all over the Deccan. The word 'Trap' is derived from Swedish word "Trappa", meaning a flight of stairs and can be observed everywhere in Maharashtra. Their steplike appearance

is due to peculiar mode of weathering of trap rocks. As regards the geology of Maharashtra, 90 per cent of it is made up of Deccan Traps. Another important formation is the Gondwanas seen in Bhandara, Chandrapur, Wardha, Wardha-Godavari Pranahita valley and in Konkan. In Konkan small areas around Kanakeshwar at Redi and Jaygad have the Archaeans. These however are only very small areas mostly at the periphery of Maharashtra. The main body of it is made up of the consolidated lava flows poured out at several places by igneous action cooled and consolidated later.

The volcanic action was intermittent. These lava flows must not, have come out as a cataclasm all over at a time but for a long time intermittently. The intervals in between two eruptions must have been long. The Deccan traps have been spread over an area of 38,850 sq. Kilometres on the earlier surface of the earth which was not flat like a table-top but undulated, either Vindhyan, Lametas or Infra trappean or Gondwanas. The hot fluid lava filled all ups and downs on the ancient surface and the Deccan assumed a shape of flat terraces over terraces. The lava in some parts was brittle and it got weathered and disintegrated earlier, so that step-like form was assumed by the strata, leaving harder core in tact. The present shape of the Deccan traps was moulded by subsequent continuous weathering and wearing.

The Deccan traps occur in very distant places; at Rajmahendry on east coast in Andhra Pradesh, at Shillong peak in Assam, at Jwalamukhi in Punjab, in the Runn of Cutch (Kala dungar), in Girnar in Saurashtra, at Pavagarh in Gujarat, throughout Maharashtra, Madhya Pradesh and Goa and in northern districts of Karnatak. Their occurrence over vast area from Guna in Uttar Pradesh to Goa in Western India, having varying number of lava flows of different thickness one over the other, cannot be a single event. Rather the whole activity must have been spread over a long time, 70-80 millions of years from the end of Cretaceous to Pleistocene. Throughout this long period, the Deccan was a perpetual burning furnace fuming and steaming after the initial sporadic explosions. The highest volcanic activity was in Maharashtra in the Western region in Khandala ghat area. It continued with a full vigour in early period, got some-what quiescened for some time and again resumed pouring out lava not all at a time or at the same place, but at intervals.

This long and protracted character of volcanic action is evident in many places in Maharashtra in the form of dykes and sills, fossilized water channels, beheaded rivers like Vaitarna, Umred river, etc. Previously geologists used to believe that the Deccan traps were poured out in Cretaceous period. But Professor Birbal Sahni F. R. S. has conclusively proved that the greater part of Deccan traps was poured out in early Tertiary period in Eocene (Sahni 1940). The present opinion however, suggests that they began in a small way at end of Cretaceous, reached a high mark in Eocene, continued with less vigour in Oligocene and again became more active during Miocene at Cuddlore and ended in early Pleistocene.

Professor Sahni (1940) has given a graphic picture of this event in his Presidential Address on "The Deccan Traps" to Indian Science Congress in 1940 at the Madras Session, of which he was a General President. It is as follows:—

"The Deccan lavas, being rich in iron, are of a specially fluid kind that takes long to set. They flow almost like water filling up hollows in the land and spreading rapidly in horizontal sheets, covering miles of country before they harden into the basalt or 'trap' rock that is familiar to us. In its devastating march the 'firey del ge bakes up the soil and consumes all surface vegetation. The very earth is on re.

Pools and trans begin to seethe as the lava flows over them. Here and there a stream is dammed up and collects its waters in a temporary lake till it finds or makes a new channel, or the lake itself is covered up by another eruption. The bigger rivers, not so easily blocked, manage to keep their old course, gradually cutting their way through any lava flows that might cross their path. But the eruptions continue from time to time, and from place to place over an enormous area, originally perhaps half a million square miles, from Rajahmundry to Cutch and from near Dharwar almost as far as Jhansi; piling sheet upon sheet of molten rock and loading the old foundations under a plateau thousands of feet thick. Even after continuous erosion of millions of years the Deccan traps still cover an area of 5,17,998 Sq. Km. and you can travel all the way from Nagpur to Bombay, a distance of 837 Km. without ever stepping off the volcanic rocks. Their abrupt ending along the West coast, where they are thickest and form the great scarp of the Western Ghats, leaves us no real measure of their original extension into the tract of land that foundered into the Arabian Sea.

It is difficult to tell where, in the enormous area of the Deccan traps, this igneous activity first began. The trap of the Nagpur-Chhindwara region were certainly among the earliest to be poured out and so far as we know at present, the highest flow of the series is to be seen on Malabar Hill and at Worli in Bombay. It appears the vulcanicity began in the eastern parts of the Deccan and gradually spread to the west.

The lava flows vary in thickness from a few feet to as much as a hundred. As one flow overlaps another, it seals up the old fissures, and any later eruptions have to force their way up through the entire pile. Theirs is a tremendous outburst. A fresh crack has been rent open, or an old one has split wider. The yawning mouth of Hell roars with thunder, and hurls fire and smoke and ashes miles up into the sky, as if spitting curses on Heaven itself.

The ash comes down again, raining upon the lava still hot round the fissures perhaps raising a mound here and there; or it extends the desolate waste by burying under its weight any fresh vegetation farther afield. Beds of volcanic ash abound in many parts of Western India, specially round Poona and Mahabaleshwar. There must be an eruptive centre in the vicinity.

If a lake or river happens to be nearby, the ash settles down on the water, forming a sort of volcanic sediment in which the creatures living there find a speedy grave.

But it is an immortal grave. For, through a process that is still largely a mystery to us, the bodies of these plants and animals become imperishably preserved. Particle for particle, cell for cell, the plant tissues are replaced by silica derived from the ash, or from a lava flow that may have overwhelmed the lake; and in the end we are left with an exact replica of the original in hard, indestructible silica."

(Extract from: Twenty-seventh Indian Science Congress, Madras, 1940.

General Presidential Address by B. Sahni, The Deccan Traps: an Episode of the Tertiary Era. pp. 7, 8).

8. GEOLOGY AND COMPOSITION OF DECCAN TRAPS

The Deccan traps are thick bedded piles of consolidated lava flows having a maximum thickness of 3048 metres, along the Bombay coast. This becomes rapidly less towards east and at its southern limit, they are 610-760 metres high. At its extreme eastern limit they become 152 metres. In Cutch in the Anjar area it is 760 metres. At extreme northern limit it dwindles to 30-60 metres. The individual lava flows on an average are 4-5 metres each, and their number varies. For example at Linga Dr. Fox counted 13 flows one over the other. They are separated from each other by a thin parting of ash, scorie, green earth or by beeds of tuff. volcanic ash or other intertrappean sediments. In the lower part of traps such beds are rare. The ash is supposed to have come from local vents and fissures. The traps are mostly arranged in flat layers and very rarely are in the form of cones as one notices at Ankai near Manmad or at Haji Malang near Kalyan. But they are not so uncommon in African traps. The eruption of lava was rather quiet, not violent or explosive, being from fissures. There is plenty of evidence of volcanic action in the whole area. They are generally hori-

zontally disposed but sometimes they have 5° westerly dip. At times they show slight folding of lava sheets in the western parts of the Satpudas in Khandesh and in Rajpipala Hills (South Gujarat), but that is probably secondary, in nature.

The traps are of two kinds depending upon their acidic or basic nature, with all intergrades. When the lava flows are more acidic in nature, they form trachytes, daycites and have yellowish brown or buff colour, rarely a red or pinkish purple. Sometimes they are coarsely crystalline doleritic, vesicular, scoriaceous or amydalodial. The cavities in them are filled with secondary minerals like calcite, quartz, zeolites. They have concoidal fracture. The lava was very fluid, It crystallized rapidly. Thus one sees acid, basic and intermediate varieties of traps. The Girnar traps in Saurashtra, the traps at Pavagarh, those at several places in Bombay Island are acidic and look yellowish brown. For example, the Gateway of India, Institute of Science, Bombay High Court buildings have been built from such acid differentials which are yellowish in colour. They are made up of trachytes, and rhyolites.

The ability of Deccan traps at different places to wear away differs, with the result that throughout the Deccan Trap country one notices various shapes of plateau basalts, made up mostly of fine-grained plagioclase, augite. Magentite is disseminated throughout. The ground mass is dark green or gray in colour. Silts and dykes are plentiful, particularly between Bombay and Pune. Here Agashe and Gupta found 120 dykes in the ghat region. Some dykes occur in the river beds also, or at very high elevation. They are locally known as "KAR". Their importance lies in the fact that they produce weakness in the strata, and when a river bed changes its course, their walls function as bunds. When dykes occur in the river dam area they have to be carefully plugged before impounding water mass; and special precautions have to be taken by the engineers while constructing dams and reservoirs to avoid weakness in certain spots in the dams, on account of dykes and sills. Chemical composition of Deccan traps is as follows according to Wadia (ch. 10 p. 216)

THE CHEMICAL COMPOSITION OF DECCAN TRAPS

SiO ₂	50.61	K_2O+	0.72
Al ₂ O ₃	13.58	$H_2O +$	1.70
Fe ₂ O ₃	3.19	H ₂ O—	0.43
FeO	9.92	TiO ₂	1.91
MgO	5.46	P_2O_5	0.39
CaO	9.45	Cr ₂ O ₃	none
Na ₂ O	2.60	MnO	0.16
		Specific gravity	100.12
			2.96 (vide Wadia 10-216)

As regards the minerals in them they are generally as follows:—

Quartz			 4.14
Ortholasa			 4.45
Allite			 22.01
Anorthite			 23.07
Diopside			 17.41
Olivine	•••		
Magnetite	• • •	• •	 4.64
Ilmenite,			 3.65
Abatite	••	••	 1.01

Occurrence of Titanium oxide TiO² in it is very noteworthy and also Ilmenite. They have a tendency to weather spheroidally, following exfloated concentric shells often seen in Khandala ghat or in the ghat between Aurangabad and Chalisgaon. Prismatic joints colamnar structures, steplike perpendicular escarpments are seen a Andheri and other places in Bombay. But more often basalt layers assume the shape of steps of a stair. Such weathering of trap rocks is characteristic of Deccan all over the area. Chalcedony, agate, ash, carneline, jasper, quartz crystals of different colour tints occur in the gas or other cavities in them. Zeolites and other secondary minerals like calcite are common. Rarely asphalt or bitumen also occur as at Dongri in Bombay Island, Malabar and Mazgaon Hill, etc. But by far the most significant features of the Deccan traps are the laterite soils, and intertrappean beds containing fossils. It is not unusual to find only red bole and soil without any fossils, especially in the Middle traps having a depth of about 1220 metres. The stratigraphic sequence of the Deccan traps is as follows:—

Nummulitic Beds of Surat and Broach, Eocene of Cutch laterite unconformity.

Upper Traps 457 metres .. Bombay and Kathiawar traps. Mere

ombay and Kathiawar traps. Mere lava flows, contain numerous ash beds. Sedimentary intertrappean beds of Bombay Island contain vertebrate fossils e.g., Indobatrachus pusillus and Indobatrachus trivialis, Horaclutea, Palaeopristolepis Hydrapsis. Ostracode and unid shells and very few plant remains.

Middle Traps 4000'

... In Malwa, Central India, the lava and ash beds form the thickest part of the series. No fossiliferous intertrappean beds.

Lower Traps 500'

.. Madhya Pradesh, Narmada basin, Vidarbha etc.

Lavas with a few ash beds. Intertrappean beds, many, rich in fossils, both plant and animal.

As the lava erupts and moves in flows, the length and spread of individual flows varies much. In the Lower Traps at Linga in Chhindwara district (M.P.). Dr. Fermor found as many as 13 flows of variable thickness and lengthwise spread one over the other. On the whole they

contain 43—73 per cent Silica Basic and ultrabasic traps contain 45-51 percent Silica; intermediate types contain 51—61 per cent Silica whereas acid types contain over 61 per cent Silica. They show distinct progressive change in composition in their normative value, namely, decrease in quartz, total iron, total water, and in alkali feldspars and Pyroxene. Their composition on the whole however, is nearly the same. Generally it is considered that Bombay and Kathiawar traps are the youngest. Madhya Pradesh and Malwa traps are intermediate and those in Nagpur-Chhindwara area the oldest. But from the view point of flora the intertrappean beds in the Deccan are important as they contain a number of fossil plants and animals which help to trace the history of climate and vegetation in Deccan.

9. INTERTRAPPEAN BEDS-THEIR EXTINCT FLORA

The Deccan traps are spread over a wide area of 20,00,000 sq. miles from Guna in M. P. to Berar, and from Bombay to Bidar and Gulbarga in Karnatak. There is a sub-terranean junction in Kathiawar and Cutch. Their outliers lie on the east coast at Kateru, Pangide and Rajmundry, Cuddulore and Pondicherry and even at the Shillong peak. They form a continuous mass of igneous crystalline rocks spread in Central and Peninsular India forming part of several States-Madhya Pradesh, Maharashtra, Gujarat, Andhra Pradesh and Karnatak. The energy required to raise such a vast mass must have been tremendous which was probably provided by the radio-active elements in the Womb of Earth. As the highly fluid lava flows cooled over varied earlier surface generally Vindhyan, rarely Archaean, and sometimes intermediate Lametas. At Surat near the village Khoba and Tarkeshwar the upper junction of the traps is reached with Nummulitic beds, occurring as the last part of Tertiary. At Rajmundry they lie above Cretaceous. At Worli hill in Bombay, in Ankaleshwar area in Broach (South Gujarat), in Saurashtra and Kerala they form intertrappean sediments. Due to local variation in the composition of lava flows they form acid or alkaline rocks mostly in the form of plateau basalts basic in nature. At Junagad and Girnar in Saurashtra, one notices acid and alkaline traps and intertraps also.

The volcanic activity bursts suddenly, continues for some time and then lapses into inactivity. After a quiescent period of several years, sometimes hundreds and thousands, to erupt again, there is resurgence of eruption of lava believed to be of the order of 5 million years. In between two quiescent periods soil accumulates between two lava flows. and the process of sedimentation goes on. During volcanic action gases. the steam, ash, hot mud, tufa are thrown out in great quantities and they cover the surrounding areas, burning and killing all plant and animal life around as it happened in Pompei in Italy. At times this amount of ash is so great that sky is overcast and every thing looks dark. Tufa then settles down on water, and gets partially dissolved. It consists of Silicon trioxide (SiO₃) which is partially soluble in hot water. During volcanic eruption water of the lakes and rivers gets warmed up and boils. The volcanic ash gets dissolved in it. Animals and plants die either due to suffocation of gases coming out of creator or fissure or of heat. The dissolved ash and clay in hot water provides slurry for immediate silification of plants, animals, their parts and entombs them. The action is sudden and there is cell to cell diffusion. and particle by particle replacement. They are preserved in an admirable good way. The amount of carbonized matter varies in them and is mixed with sedimentary clay. Sometimes the shallow ponds dry up

and the sediments get heated up like bricks in a kiln due to excessive heat and the burning action of volcano. Thus one finds fine Molluscan shales preserved in silicious mud and clay. Sometimes the organic matter is charred and burned up and only carbon remains in silicious mud and in the form of chalcedony. But it contains no fossils. The sedimentary soil is also completely burned up to form lateritic soil or red bole which is unfossiliferous. Such soils get leached out and form laterite. By further weathering and bacterial action the so-called 'Regur' soil is supposed to have been formed on maturity.

Fossiliferous inter-trappean beds are found at certain places only, where perhaps there was rich vegetation or shallow lake or a river. They are particularly abundant at the periphery of the Deccan Trap country in the Lower traps. Their occurrence in Upper traps is rare and very rare or scarce in the Middle traps. They may even be absent. Wellknown Frog Beds at Worli of Oligocene-Miocene period, Cuddulore and Pondichery series, Upper sandstone series of Rajmundry of the same period are some examples.

From current researches and the fact that in Andhra Pradesh the Deccan Traps are resting on Cretaceous rocks suggest that volcanic activity of Deccan Traps had already started towards the end part of Cretaceous and early Pliocene period and gathered great momentum in Eocene. These are the early traps. The intertraps in Nagpur-Chhindwara, Shivani region seems to be the main focal area where inter-trappean beds are found at many places. They contain chertified material whose preservation is as good as that of Primofilices of Chemnitz in the Province of Bavaria in Germany and better than that of Rhinean cherts of Scotland. The list of plants so far known, is given elsewhere.

To put it briefly about 167 taxa of plant megafossils are known apart from of animal fossils about 25. They throw a good deal of light on the Palaeo-geography, climate, flora and fauna of Deccan then and provoke many problems as they contain such diverse elements as do not exist in India today, but occur in Brazil, Australia, Europe, Baku. etc. They comprise both tropical and temperate species which have provoked controversies as to their origin, distribution and affinities. The last part of Tertiary era also contains some modern general existing in India today, but not necessarily in the present Deccan Trap country suggesting thereby migration of genera and extinction of species.

The most burning question for which no satisfactory answer is yet obtained is the question of the age of the Deccan Traps. The question rather is of the range of volcanicity in the Deccan Trap country, their first occurrence and subsequent spread of the different parts of Sahyadris or the Western Ghats.

Recent oceanographic studies in the Arabian Sea and the Indian Ocean have shown that the west coast of India has been continuous with the wellknown Carlsberg Ridge in Indian Ocean and perhaps further beyond towards the East coast of Africa. This ridge is supposed to have arisen due to the activity of a submarine volcano or a series of them. All these factors have a strong bearing on topography, soils and climate of Maharashtra, apart from the age of the Deccan traps.

10. CLIMATE—GENERAL

One of the chief factors that govern the life and distribution of plants is climate. Plants are fixed to the soil on which they stand, and half their story is hidden underground. Their aerial half part is largely affected by atmospheric changes and the underground part by changes in the soil mainly. The fixity of life imposes severe restrictions on the life of plants. Therefore, while delineating the life processes of plants, it becomes necessary to consider first the factors that go to make up the climate and then soil. The soil in its turn is affected by climate. The climate thus has an overall effect on plant life directly as well as indirectly.

The climate comprises temperature, rainfall, humidity, winds and their velocity, rate of evaporation, light or radiations etc. It is customary to differentiate between weather, climate and micro-climate. The term 'weather' is applied to all changes in the atmosphere that take place over a large region, climate to atmospheric changes that occur over stipulated period of time like X'mas, or a week, at a particular place, and micro-climate refers to the zone of air 76·2 to 101·6 mm. to a foot above the surface of soil. It largely affects germination of seeds, development and growth of seedlings, their survival or mortality.

11. THE CLIMATE OF INDIAN SUB-CONTINENT

The climate of India on the whole is monsoonal and is fairly well stabilized. It is however largely governed by the factors operating outside India and by lands and Oceans that surround it. Similarly the climate of Maharashtra is affected by the climate of States surrounding it and by the Arabian sea and Bay of Bengal. It is therefore necessary at the outset to understand the peculiarities of weather of India of which Maharashtra is an integral part.

The rainfall pattern of India and adjoining countries is also dominated by monsoons. The vegetation, forests, flora, agriculture, water-supply, nay even the life of people, is affected by monsoons. We shall consider them first.

12. THE MONSOONS AND SEASONS

The monsoons are a periodic movement of winds originating in Indian Ocean far beyond the Bay of Bengal and Arabian Sea, approximately 20° on both sides of the Equator. They blow more than 6437 kilometres and come in early June with great gusto in South Westerly direction moving a long distance over the sea. They touch India in two streams one coming at the end of summer as south-west monsoon. It crosses Arabian Sea and moves northwards. On reaching Gujarat, it gets deflected eastwards and goes over the Indian subcontinent towards Assam NE. The other current comes over Bay of Bengal and flows over NE or NEE. Both are regular in coming over from Indian Ocean and are considered to be a thermal phenomenon. The SW current touches the West Coast of India in Kerala by about first week of June and moves north-westwards and reaches Bombay by about 7th of June and moves towards south Gujarat. Then it crosses over to the plains of Central India and goes NE right upto Assam through the valleys of Tapi and Narmada. Though they are regular to arrive are rather vague and inconsistent and uneven in distribution. The other current comes late and is dependable.

The effect of regular periodic movement of monsoons has made it possible to recognize the following principal seasons throughout India:

- (1) Hot weather season—Summer.—March to May.
- (2) South-west Monsoon or Rainy season or Varsha Rutu.—June to September.
- (3) Returning Monsoon season, partly wet and parttly dry season from October to November—the Autumn.
- (4) Cold weather season—Winter from December to February.

These four seasons occur with some variation in different parts of India because the monsoons are never uniform everywhere.

A great uncertainty of rains prevails in different parts of the country affecting crops and subsoil water. There is hardly an year in which famine condition or heavy rains do not occur in some part or the other of India.

13. CLIMATE OF MAHARASHTRA

The climate of Maharashtra is also monsoonal. Arabian Sea and the barrier of Sahyadri mountains control it, the former by its cooling effect and the latter by its altitude. The tropic of Cancer lies rightly to its north at 23.5° N Lat. Sun's rays therefore hit earth nearly vertical. Rainfall and humidity in Konkan and hill tops make climate there suitable for certain plants and equable for man. it shows no extremes of either hot or cold as in north. It is equable and suitable in winter for all kinds of crops throughout the year. The real limiting factors for crops are want of adequate rainfall and humidity particularly on the Desh side. Depending upon these eight agro-climatic zones are recognized in Maharashtra.

Generally from the last week of March to first week of May, it is very pleasant in Western Maharashtra. But in Vidarbha it is hot, and like Mediterranean hot and humid in Khandesh. A peculiar type of climate intermediate between that of hill tops and in plains on Desh side prevails in Mavals. It provides very salubrious climate in cities like Pune, Nasik, Kolhapur, Belgaum, Satara. The average rainfall here is not high nor the altitude great, only about 365.76—610 metres. They are also close to sea, and not far from Sahyadris. Humidity is neither low, nor high as in Bombay or Konkan.

The climate of Khandesh and Tapi Valley is very hot in summer, and cold in winter. There is however no drought like that in Solapur, Ahmednagar or Daund region, as the water laiden winds from Arabian Sea flow through the valley of Tapi. Vidarbha has deep black cotton soils. They absorb lot of heat from Sun's radiation during day time in summer months April to June, and emanate it at night. In fact Akola in Vidarbha is one of the hottest places in India, the highest temperature being 120° F. In eastern Vidarbha at Chandrapur, Bhandara and Nagpur the summer climate is dry but temperature range or its duration in day time, are not so high as at Akola. Pre-monsoon showers and thunderstorms are not uncommon.

It will be seen from the above that there is such a variable climate, range of temperature, rainfall, humidity and topography in Maharashtra that different types of plants and crops thrive here.

14. Rainfall Pattern, temperature and Humidity in Maharashtra—

The main form of precipitation in Maharashtra is monsoon. The other forms such a mist or snow are not there. Fog is seen in regions adjoining Belgaum and in the valleys of Khandala, Mahabaleshwar, Melghat in the pre and post-monsoon period early in the morning, when the humidity is high and variation in day and night temperatures is wide. They are generally supposed to be caused by radiational cooling. Squalls accompanying thuderstorms are frequent in Nagpur area. Hail storms for a day or two occur all over Deccan plateau in April and May.

The rainfall is mostly due to south west monsoon and its pattern is very variable in the whole of Deccan Trap country because there is a good deal of variation in temperature during day and as well as seasonal ones. In the northern part of Maharashtra there is generally a slight tendency towards accentration of maritime climate. The total rainfall, therefore, in different parts of Maharashtra is not uniform. The Konkan and coastal regions get rains regularly about 2540 mm. per year, but much of the water that falls goes to sea due to steep incline of the land. The rocks here, mostly lateriatic, have poor capacity for retaining water. The result is for four months of the rainy season there is incessant rain, and conspicuous absence of if for the rest of the eight months of the year. Despite this, humidity in Konkan never goes below 60 per cent as in Calcutta. On the Desh side it is quite high for four months of the rainy season and low for eight months (October to May). The relative mean humidity is as high as 80 per cent in July-August, but the lowest in March-April. as low as 25 to 30 per cent.

The mean vapour pressure is lowest in January-February about 10-11 mm. and it rises high in monsoon months, the highest being in July. The rate of evaporation is also quite high in this period, it being the highest at Aurangabad, it is lowest during monsoons. At Pune it rises to 15.01 mm. in April and falls to 3.81 mm. in September. At Nagpur it is highest in May, 19.74 mm. and the lowest in December, 4.37 mm.

The highest annual rainfall in Vidarbha is at Dhanora in Chandrapur (1736.00 mm.). At Mahabaleshwar it rises to 6226.3 mm. The lowest rainfall is in Solapur district at Akluj 448.8 mm. This shows how erratic is the pattern of rainfall in Maharashtra. Day temperature and the number of rainy days also show significant differences at different places. The highest number of rainy days is 120-140, and the lowest 25-40. All these extremes lead to vagaries of monsoons and are reflected in the vegetational pattern and flora on the two sides of Sahyadris. On the Konkan side, in valleys, and sunny side of mountains, humidity is generally high throughout year and plants look lust green. The palms, mangroves, wild vines and fruit trees such as mango, nutmeg, chiku, lichi thrive well, despite a few cyclonic and thunderstorms, throughout the coastal areas from Goa to Surat except on the rocky denuded areas such as Deogad. The amount of rainfall, temperature, humidity and evaporation at Ratnagiri, Jaigad, Deogad, Malwan, Vengurla, Dapoli, Bombay, Thane, Karjat, Khandala are quite different. They clearly show a great contrast with those on the Desh side areas. The high level plateaux such as Matheran, Mahabaleshwar, Lenavla Tryambak have relatively high rainfall, but the vegetation does not look much different from that on the Desh side, as it gets dried up and completely parched in summer months. The natural underground water small reservoirs get dried up and rivers become lean. The vegetation except in the littoral zone is also partially dried.

15. WIND MOVEMENTS

During the summer months and rainy season (May to October) movement of wind is from sea to land and is from land to sea during winter. Since the wall of Sahyadris lies at right angles to the winds coming over from the Indian ocean northwards, they hit it and get deflected South-West due to rotation of the earth. The Sahyadri ranges obstruct the water laiden clouds as they ascend them. Naturally the rainfall on the top of the Ghat region and in the regions in the immediate vicinity of Sahyadris is high. Thus Mahabaleshwar gets 6200 mm. rainfall and Amboli 7477 mm. The temperature here is low due to their high altitude. Average mean temperature here is 17.7° C in January and rises to 24° C in April. There are no frosts except an occasional thunder shower in winter months and early May. The mountain top and high ranges do not store much water. It gets washed down to the valleys and with it carries the surface soil. The small amount of soil accumulated by disintegration of surface layers of rocks is also removed by winds. The winds are quite strong from sea to land till October and in the latter part of April. The trees on mountain top consequently grow low and stunted e.g. Syzygium Cumini grows 9 to 12 metres heigh in plains and valleys, but at Mahabaleshwar on hill tops, it hardly grows 2.4 to 3 metres. The same thing is true of Alstonia scholaris growing in valleys on Konkan side and on the top of mountains. It is interesting to note, however that here and there pockets of evergreen vegetation and humid monsoon evergreen forests are formed in the valley and in a few places in the Satpuda range in Melghat at Chikhaldara (Amravati district) and at Khandala in Sahyadris where the vegetation has optimum conditions for growth and the plants well protected. These pockets of evergreen vegetation in Konkan, and in Maval region on Desh side look something like the Shola pockets at higher altitude in Nilgiris. They are generally small belts of about 20 to 30 km, vide, drained by some small river or a stream. They have continental climate, pleasant in winter and cold in summer with moderate rainfall. The temperature variation during day and night not being much e.g. at Ambavade near Bhor the summer temperature is 26°C-29°C and in winter it is 23°C. The rain fall is 1016 mm. Hooker and Thomson (1855) have attached special importance to the Maval region and they consider it to be a separate entity from the floristic point of view.

On the eastern side of Maharashtra—the Desh presents a different picture. It lies in the 'Rain shadow' region which forms the major part of Western Maharashtra. Here the rainfall in the immediate vicinity of Sahyadri ranges is high, but a few km, further there is a sudden drop. It becomes progressively less and less as the clouds move to the east and north. As they cross the top line of the ghats, they become light and depleted of water and get scattered over the Desh side. They get again heated up by the heat emanating from the earth's surface and their water capacity becomes less and less on their north and eastward movement. The clouds get rarified as they pass on the Desh side, and rainfall becomes low.

A special mention must be made here of the dry belt of Maharashtra where rainfall is the poorest, humidity low, temperature and evaporation rate high. It comprises part of Ahmadnagar, Solapur and Osmanabad districts where famine conditions persist year after year. This is the scarcity zone of Maharashtra. Elsewhere in Maharashtra, on an average the rainfall is 381—508 mm. and average temperature 26°C to 38°C. The difference between day and night temperatures is about 5°C—10°C. So they do not fall in the scarcity area. But in famine zone mentioned above it is just the reverse of this.

In Khandesh, South-West monsoon clouds escape through the valley of Tapi and through the annual mean temperature is high, the rainfall is only 900 to 1000 mm. This is because they get a part of precipitation due to easterly North-East monsoon over the Bay of Bengal and the return monsoons. These are very helpful for Rabi crops in Khandesh.

In the region of Western Vidarbha the temperatures are quite high, the annual mean being more than 40°C. The rainfall is about 975 mm. It also receives some rain due to return monsoons during October and November. The Eastern part of Vidarbha, comprising Chandrapur, Bhandara and Nagpur, gets substantial rains from the Bay of Bengal monsoon current in August to September and even later. The humidity becomes high and temperature low. The rainfall is between 1200—1400 mm. The soils are both sandy and/or black cotton trap soils. They support rich forest vegetation. As a matter of fact Chandrapur and Bhandara districts have the best forests of Maharashtra. The thunderstorms are quite common. In mountainous region and valleys fog is there in winter.

In Khandesh frost is occasional at early morning hours in winter. The water condenses due to drop in night temperature and high humidity. The rate of evaporation in this region is highest between Dhule and Jalgaon and next to that in the region between Nasik and Yeotmal. The water evaporation due to transpiration from forest trees does not make much difference in the humidity on Desh side, as there are no thick forests worth the name, and they are mostly deciduous.

16. Underground Sources of Water in Maharashtra

The other sources of water are the underground aquifers. They have been surveyed in some regions of Maharashtra by Dr. Adyalkar and others (1977). Dr. Adyalkar (1975) found that in Narmada, Tapi and Purna valleys there are a number of regions with fairly good sources of underground water. They occur both in the valleys and also in plains. Their presence is extremely helpful for the supply of water to rivers and wells. Especially they are of much help to summer crops in the alluvial basins.

The quality of water in most places is good. Dr. Adyalkar thinks that there is a good possibility of getting water-supply from aquifers even in the lateritic and red bole soil regions if properly surveyed and tapped. Soil in the intertrappean layers often gets leached and washed out the cavities so formed get filled with water. Thus huge underground water reservoirs are formed in such cavities in Sahyadri mountains, e.g. at Sinhagad, Raigad, Panhala, Purandar Forts standing above 762 metres. The underground water here is sweet and not saline. But it is saline in fountains of Tapi valley, Solapur and Manmad region, and in a narrow belt in Purna valley. For example in the region of Vivra, Rajura,

Javal, Torkheda, Taloda water is saline. There are also underground limebeds, either sedimentary or concretionary in the Wardha and Vainganga valleys. Concretionary limebeds or their patches occur throughout Maharashtra below the black cotton soil at various depths. They are a sure indication of past locus of the sub-soil water in these regions. Hence Dr. Adyalkar has suggested that if there are limebeds below the vesicular trap there is a possibility of getting subsoil water.

The pH of subsoil water is either neutral or slightly alkaline 7.5 to 8. In Narmada basin concentration of Sodium (Na) or Postassium (K) is less than 8 to 9 ppm. Sodium salts (chlorides) are 5 to 10.3 ppm. On the other hand the proportion of potassium and chlorine is higher, 100 to 300 K and Cl 345-1080 ppm. Chlorides in the underground water in the Purna valley basin are still more. The underground water in Tapi valley has 7.2 to 8.5 pH in some places in Jalgaon district. It is sometimes still higher. A few isolated patches of saline water also occur in the valley of Purna river with high percentage of Calcium carbonate (CaCO₃) 160 to 451 ppm. The pH of subosil water in the valley of Purna varies from 7 to 8.4 suggesting slight alkalinity. The chloride content varies from 1000 to 5000 ppm, but the percentage of sodium and total solids dissolved is higher. Thus a variable salinity and alkalinity is a general feature of the soils and of subsoil water in Maharashtra. It is not very high, but when the non-carbonate alkali salt is responsible for the primary salinity, or when both get mixed then the water is not useful for irrigation purposes. The sulphates or sulphides are rarely found. Generally shallow waters are good for irrigation rather than deep flowing water from aquifers which have more mineral salts especially chlorides; and hence they cannot be used for all crops. Because all crops or plants are not resistant to high salt content in soil or water.

17. Temperature

Next to rainfall the most important factor for plant life is temperature. It depends upon the direction of solar radiation, nearness to sea and altitude. There are four distinct regions in Maharashtra on the basis of temperature variation:

- 95 to 100 F.
- 2. About 100° F.
- 3. 105-110° F.
- 110.120° F.

The lowest temperature is in the coastal region of Konkan from Ratnagiri to Goa, Bombay, and Kosbad due to nearness of sea. Highlands, of Maval region and hill tops also have low temperatures due to altitude. The temperature in the forest zone varies between 86° to 100° F. The places such as Pune. Nasik, Satara, Kolhapur etc. lie in second zone. The third zone is partly humid and partly dry.

There is no snow-fall at any time in Maharashtra and so the sudden cooling of climate is never experienced. However, in winter when cold winds from the north come over from already cold Northern India, then the temperatures in Maharashtra get lowered. The data regarding rainfall and temperature is given in the table No. I-1.

TABLE No. I-1

RAINFALL AND TEMPERATURE AT DIFFERENT FLACIS

							•	RATNAGIRI	iR1	٠.						
Month			ŗ	Ħ	M	*	∀	M	r	ŗ	¥	S	0	Z	Ω	Annual
Rainfall mm.		:	<u></u>	1.0	0.3	t.	3.6	30.7	709.9	849.9	483.1	333.3	103.9	35.3	4.3	2,61.71
Temp. Max. °C	_	:	30.3	29.8	30.6	31	31.6	32.3	30.3	28.7	28.6	28.8	31.2	32.6	31.4	
Temp. Min. oC	•	:	19.5	19.8	22.4	25	25.0	26.6	25.1	24.4	24.2	23.7	23.6	21.7	20.1	
						4	é		8	d						
						सय	5	Greath Bombay	JMBAY							
Month			r	ជ	×	्र भेव	1	M	1	26	¥	Ω.	0	z	Q	Annual
Rainfall mm.		:	3.6	1.7	Ξ	2.0	0	17.8	470.4	2.699	371.9	290.9	70.1	16.6	1.5	1,917.3
Temp. Max. °C	•	:	28.5	28.6	30.3	31.8	A	32.9	31.5	29.7	29.5	21.8	81.6	31.6	30.4	
Temp. Min. oC	•	:	19.3	19.8	22.2	24.6		26.5	26.0	24.9	24.6	24.3	24.3	22.9	20.5	
								PUNE								
Month			٦	Ħ	M	7	Ą	Σ	r	ı	¥	S	0	z	Q	Annual
Rainfall mm.	_	:	1.9	0.3	3.1	17	17.6	34.7	102.8	186.8	106.4	127.3	1.9	37.0	2.0	624.7
Temp. Max. °C	•	:	30.3	32.5	36.5	38	38.3	38.2	31.9	28.5	27.6	29.2	31.9	30.27	29.4	:
Temp. Min. oC	•	•	11.6	12.8	16.5	20.1		22.4	23.5	22.5	21.4	20.5	19.5	14.6	11.6	:

					ENV	IRÓN	MEN	TAL	FAC	TOR\$						23
	Annual	1,034.5	:	:			Annual	621.9	:	:	•		Annual	725.8	:	:
	Ω	4.5	28.3	10.2			Ω	6.8	28.9	11.7			A	8.9	28.7	13.3
	Z	28.0	30.4	13.2			Z	36.1	29.6	14.7			Z.	31.0	30.2	15.8
	0	59.1	31.6	17.7			0	57.7	31.4	18.7			0	47.0	32.0	19.4
	ω	184.0	28.3	19.7			ß	175.5	30.0	20.0			ω,	107.2	30.0	20.7
	4	227.5	27.6	20.9			¥	73.7	29.6	20.7			Ą	122.89	29.4	20.9
	1277	341.4	7.72	21.8			4	5.76	33.6	21.5			-	173.5	29.9	21.6
	,	158.3	32.7	22.8		W.	T.	128.3	38.9	22.3	,	ā	'n	134.1	34.6	22.9
Nastk	×	18.6	37.4	21.5		AHMADNAGAR	M	20.8	38.0	22.4		Aurangabad	M	16.8	39.8	24.4
	¥	5.4	36.2	18.9		A	A A BOOK	10.7	38.0	21.1		Αt	. «	ج. 80	38.6	23.3
	M	1.7	34.7	15.0			W		35.3	17.4			M	4.1	35.6	19.6
	11.	1.7	29.9	11.3			江	1.5	31.4	13.4			ĬŦ,	24.3	31.4	15.4
	-	4.3	28.4	10.1			-	7.1	29.2	11.9			-	7.4	29.3	13.8
		:	:	:				:	:	:				:	:	:
	Month	Rainfall mm.	Ç	Temp. Min. °C			Month	Rainfall mm.	Temp. Max. °C	Temp. Min. oC			Month	Rainfall mm.	Temp. Max. °C	Temp. Min. oC

TABLE No. I.1-comd.

	Annite	\$ 008	Case	: :		Americal	1 242.2	4.7.76	:	:		Annual	7.796 1	* /24/1	: :
	Q	11.2	203	11.9		ב	3 0	27.7	14.4	1		2	8	28.2	11.6
	Z	23.4	31.1	14.7		2	19.8	29.8	16.5			Z	15.7	29.6	15.1
	0	37.3	33.6	19.4		¢	154.6	32.8	20.6			0	56.4	32.1	20.1
	S	151.9	31.8	22.8		Š	184.7	32.1	23.7			S	215.4	31.6	23.6
	<	159.8	30.8	23.2		¥	286.3	30.7	23.9			∀	308.1		24.0
		237.5	31.7	23.7	E		376.2	31.2	24.2			•	392.9	31.2	24.3
	•	135.6	37.3	25.8		-	222.0	37.6	26.4			_	194.6	37.6	26.6
AKOLA	×	10.7	42.4	27.5	NAGPUF	Σ	20.8	42.7	28.3		CHANDRAPUR	M	13.7	43.0	27.9
	V	4.1	40.8	23.9	6	्र द्या	16.3	40.3	25.1		CHAN	¥	19.6	40.7	24.4
	M	7.9	37.2	18.9		×	16.8	35.9	20.7			M	14.7	37.1	19.5
	Ĩ4	10.4	32.5	14.4		ΙΉ	23.4	31.2	16.6			ÍΤ	24.9	32.3	15.3
	_	10.7	30.1	12.9		-	11.4	28.7	14.3			•	9.7	29.6	13.2
		:	:	:			:	:	:				:	:	:
	Month	Rainfall mm.	Temp. Max. °C	Temp. Min. oC		Month	Rainfall mm.	Temp. Max. °C	Temp. Min. oC			Month	Rainfall mm.	Temp Max. °C	Temp Min. °C

GENERAL COMMENTS ON THE CLIMATE OF MAHARASHTRA.

In the topography of Maharashtra as delincated above, the wall of Sahyadris acts like backbone; vast watery expanse of Arabian Sea to the west, and equally open higher level plateau on the east towards Desh-side give rise to many local variations of temperature, rainfall, humidity etc. They produce more local effects on the climate, rather than on the generalised climate of Maharashtra, as there is much local variation in respect of these factors in Maharashtra.

There are a few hill stations in Maharashtra. They have different climate than that in the plains. They have equable climate. All through Maharashtra sunshine is bright but the humidity is low. The vegetal cover is poor. The climate however, does not show extreme variations. One notices dry deciduous forests at Chikhalda, Toranmal, Ajanta and everywhere on plateaus of Desh and moist deciduous forests at Khandala, Mahabaleshwar and in the valleys of Desh. The trees turn completely yellow and dry up in summer months, but produce new foliage as soon as the humidity goes up in May.

Both in summer and rainy seasons some plants sprout and produce flowers and others produce new foliage. With the advent of monsoons the dried up trees and herbs bloom again and present fresh appearance in rainy season. As a matter of fact a special feature of the flora of Maharashtra is the sudden appearance of the Monsoon ephemeral flora on the Desh-side and in Ghats, which will be discussed later, Broadly speaking rhythms of growth and flowering in Maharashtra are tuned to the periodic rainfall and temperature. There is a short flowering season in October and a long one from February-March to late May. Latter is the major flowering season in Maharashtra and the former for the herbaceous and underground tuberous plants. Their life span is short.

18. ARABIAN SEA

Like Sahyadris another important physical factor which influences the climate, vegetation, forests, crops etc. of Maharashtra is the presence of the Arabian sea, almost parallel to the coastline of Western India. It creates weather conditions that affect Antartica. Australia, Asia and Africa. Two most significant events connected with it are: the monsoons and rifting of continents in the Southern Hemisphere. Meteorologists, geologists, palaeobotanists and plant geographers have been studying several problems connected with it.

It is well-known that monsoons cross over Peninsular India in two streams: (1) The South-West current touching west coast crossing Sri Lanka, tip of the Southern India, Kerala, Konkan, and then Maharashtra, Gujarat, Madhya Pradesh, (2) Another current NE monsoon crosses over the Bay of Bengal, reaching Assam and West Coast of Burma. Both the streams get intermingled in North India in the Sub-Himalayan region. There are different pressure zones in Northern India and on Bay of Bengal which create cyclonic storms over an area 10°-15° North of Equator where some high pressure zones arise and move towards Bengal and Bangala Desh playing havoc with the coast line and islands nearly, inundating and submerging them. No such heavy storms are known due to South-West monsoons.

The whole of Konkan area is strewn with small shallow rivers and swift streams. They also get silted up at their mouth and form estuarain beds of loose detritus or littoral concrete. Their banks get filled with mud years after years and local people put bunds across them and

build excellent fertile soil for cultivation of paddy, vegetables, orchards of coconut and areca, fruit trees like mango, cashew and kokam or Garcinia. These lands get periodically inundated by seal water in high tide and salt is deposited on them. Sometimes it is a heavy deposition and land becomes uncultivable (Kharland). But should there be some source of fresh water on the surface or underground, the salt gets leached out and pockets of evergreen vegetation and excellent fields growing certain varieties of rice like 'kala Rata' thrive on them. The same thing happens in monsoons. Good vegetables, beans and other plants tolerant of more salt content grow well there. In fact rice is grown twice here as in Goa.

They ultimately lead to mangrove and strand forests. Under somewhat similar conditions in Europe and Africa all along the mediterranean sea coast oil palm, *Elaeis guineensis* is cultivated. It yields oil which is used in the manufacture of margarine, red oil soap, vitamins etc. No such attempts have been made here despite very favourable conditions for the plantation of oil palm.

Geologists believe that Western coast of India has been submerged at least 3-4 times in the course of the evalution of the Arbian Sea. As a matter of fact there are quite a few places on the West coast of India where the ancient coastline lies high above the present sea level. For example, lignite beds occur at 18-24 metres high above the present sea level at Ratnagiri. Similar beds occur above the sea level at Worli, Dongri and Madh in Bombay, near Chiplun at the mouth of the Vasishthi river. Hot water springs are also found at many places e.g., near Vasai at Vajreshwari, Mahad and Sangameshwar. In some places the sea is quite deep forming rich pastures of food for fish, shrimps and cray fish near Deogad, Malvan, Vengurla and Vasai (Bassein). In some of these places oil has been found now.

The form of continental shelf is also different at different places on West coast, e.g., at Veraval, Ghoga, Bombay, Ratnagiri, Vengurla, Goa, Cochin, etc. The peat beds are also known. At Vasai, and Bombay High a rich source of oil is found and is being exploited. Some more are expected.

But apart from economic, strategic and commercial considerations the Arabian sea is now known to have some biological peculiarities of its own. They have been brought out by Sir Seymur Sewell oceanographic expeditions of 1919 and by the recent International Expedition of Indian Ocean in 1965-66. They are:—

- (1) The temperature of sea-water of upper layers of Arabian sea in winter is warm and in summer it is cool, because a deep flowing stream of warm water, some km wide, flows from the East coast of Africa from near Madagaskar and Somalia to the West coast of India. It closely follows the coast line of Arabia, Persia, Pakistan and thence Saurashtra, Gujarat, Maharashtra down to Kerala and Cape Comorin. This is known as Somalia current, and it help to keep the thermal equilibrium of water in Arabian sea.
- (2) Cyclones due to south-west monsoons are rare. The one that occurred in November 1948 had velocity of 128 kilometres per hour at Bombay. But such ones are very rare. They play havoc with trees which have shallow root system and get easily uprooted almost instantaneously. Nearly 90 per cent of the tall trees in the Fort area of Bombay fell that time in November 1948.
- (3) Arabian sea has a moderating influence on the climate of Maharashtra.

- (4) It is well-known that Portuguese Captain Vasco-da-Gama reached India with late monsoon winds which brought his ships to Calicut. This fact was known to early Greek navigators like Hipaulus. If a line from Madagaskar, Maldiv and Lakshadweep Islands is drawn, there are a number of small islands on it in between Africa and India framing a sort of Monkey or Lemurian Bridge. This bridge is supposed to have enabled the distribution of plants from Africa to Madagaskar to India nad vice versa. Thus there are some plants common to the West coast of India and East coast of Africa, Madagaskar, etc.
- (5) Sir Seymur Sewell who made oceanographic study of Arabian Sea and Indian Ocean, found that water of Arabian sea gets circulated coast to coast and that there is a submerged mountain ridge in Indian ocean known as Karlsburg Ridge. It is probably volcanic in origin and has basaltic rocks on its top similar to those of Sahyadris.
- (6) Salinity of water in Arabian sea varies between 3 per cent to 5 per cent in different seasons of the year. Sea water is rich in food material for sea animals and plankton at places, e.g., near Malvan, Vengurla, etc.
- (7) There are excellent mangrove forests on the West coast of India. Their peculiarities are discussed in the Chapter on Mangroves and their ecology.

19. Soils of Maharashtra

Most of the soils in Maharashtra are formed from the Deccan Traps generally from the augite or amygdalodial basalt. These soils are black, dark brown or reddish in colour, and hence are called Black Cotton Soils, or 'Regur' soils meaning thereby red soils. Some soils in Nagpur, Bhandara and Chandrapur districts are derived from Vindhyan and Goandwana formations. They form small areas of sandy or loamy soils in Bhandara, Chandrapur and in small pockets in Ratnagiri district near Redi and Sawantwadi. But on the whole they form a very small proportion of Maharashtra soils.

Black cotton soils are heavy in texture and have high percentage of clay. As such they are sticky and plastic. They swell on wetting and shrink on drying. They have adequate proportions of mineral nutrients and also micronutrients, hence they are considered good for plant nutrition. Some times they are slightly alkaline; but they are poor in humus or nitrogen. Morphologically and genetically they are similar to the black soils of South Africa, Australia and Charnozem soils of U. S. S. R. They constitute a group of black soils called Grummusel' soils spread in the tropics and subtropics of the world. They may be deep or light. Generally such soils derived from trap are deep; but when they are derived from granite or gneiss they are light and yellowish. The dark colour of the trap soils is due to clay fraction and is responsible for their sticky nature. The base exchange capacity of black soils is higher than that of red soils. Their water holding capacity and air dry moisture are also higher. The water retaining capacity decreases with the higher percentage of clay and increases with the percentage of humus. Because of this they do not get easily eroded, but loose water due to cracks and evaporation. According to well-known soil chemists Basu and Sirur their black colour is more related to their content and inorganic substances in them than to the organic matter present in them in small proportion. Generally black cotton soils are not formed at high altitude of mountains. have been matured under the long monsoonic climate in the past as at present, with its alternation of periods of short humidity and a long

period of aridity. They are one of the oldest group of soils since the Tertiary era. The temperature of the region in which they occur varies from 12°—14°C minimum and 40°—42°C maximum. The rainfall is 381—762 mm. on an average. They support dry deciduous forests or a Thorn Savannah.

In point of chemical composition they contain alumina, siliceous acid, some form of manganese oxide and dehydrated oxides of iron and calcium. Besides Maharashtra, they occur throughout the Deccan Trap country in Madhya Pradesh, Gujarat, Mysore, Andhra Pradesh and even in Rajasthan. Their clay percentage varies from 40—60 and may be slightly lower or higher. Their structure is cloddy or some times crumby with aggregates having natural cleavages. They have 10 per cent coarse clay, 20-25 per cent fine clay and 60 per cent superfine clay. They have about 10 per cent porosity, and 3—7 per cent hygroscopic moisture. The pH varies beween 7-8.5, they being generally slightly calcarious or alkaline. The amount of calcium carbonate is moderate. The black colour as already remarked is due to the presence of inorganic substances and moisture rather than due to organic matter like humus. The predominent base comprises saturating clay complex in calcium along with a small amount of magnesium. Calcium magnesium ratio is more in the upper layers of soils and decreases with depth. In some places 0.0-0.53 per cent manganese occurs in them. Boron is also present in small quantities. The main constituents of black cotton soils show high variation in different areas. Below black soil on the Desh side there is generally 'Murum' mixed some times with lime or kankar, or salt, or salinized lime and gypsum. There is no such murum under lateritic soils in Konkan. One can see all stages of laterization and ripening of soils at various stages in the Ghat sections and below them. Black cotton soils being argillaceous have a fair proportion of calcium, potasium, chloride, alumina etc. They are either neutral or slightly alkaline. Magnesium is also present in the form of carbonate. The proportion of lime is some times as high as 4.5 to 6.2 and phosphoric acid 0.01-0.03 per cent. Potasium is 0.13—0.19 per cent. These soils, if fed with sufficient water and Nitrogen, are capable of high productivity, particularly of cash crops like sugarcane, chillis, groundnut, jowar, wheat etc. In some areas on banks of Purna and Vainganga rivers, some areas of soils are saline or 'chopan' or 'usar' (calcareous), but the rest are under black cotton soil.

In the high temperature areas of Deccan Trap country sub-soil water comes to surfaces rapidly and salt accumulates on the surfaces; or it remains at a certain depth in the soil as was shown by Basu and Tagare. In low lying areas the salts get deposited permanently. As a result of evaporation, sodium chloride gets deposited either on the surface or at the bottom of the low areas and gets more and more concentrated. Due to increase in the salt content sodium and chloride ions accumulate on the surface or at the bottom. Salination tends to alkalization and the soils become saline. Salination is only one step earlier towards alkalization. Both are harmful to plant growth and affect the yield and lower productivity. In such soils sodium chloride accumulates in a definite zone in soil and the root system of plants, especially of crop like cotton, get damaged by the sodiumized layer. To avoid this, chemical, agronomic and biological methods are used; also they are drained by digging trenches in such saline soils for reclaiming. 37,586 hectares (83,000 acres) of soil in Maharashtra is damaged due to salinity and about 38,395 hectares (85,000 acres) due to alkalinity.

Naturally saline soils occur in the Khar-land zone close to sea coast, apart from the areas constantly irrigated by the Deccan canal system where excessive doses of fertilizers are used. Khar-land soil becomes saline due to periodic innundation by sea water. Khar-lands lead to mangrove soils which are quite rich in salt content and also calcium. They form an important belt of vegetation along the sea coast. The process of salinization and alkalization is as follows:—

Clay Complex—Soluble Na salts—Alkali salts—Salts of other bases like Mg.

Some soils are both saline and alkaline, Should these saline soils be properly flooded with fresh water, salts get leached out and become progressively desalined. Some varieties of paddy or vegetables grow well on them. Addition of gypsum and suitable fertilizers help to recover them; otherwise they become more and more infertile due to increasing salinity.

The black cotton soils in scarcity zone of Ahmadnagar, Solapur, Jalna, Beed and Aurangabad districts are saline and infertile, Due to high temperature and low rainfall they become unproductive. But in some years when the rains are heavy they produce bumper crops.

In some places there are yellow soils of fossil origin belonging to Miocene period. There are friable soils also of the pleistocene period. They are dark and peaty. These are of course rare.

Distribution of soil zones

Next to climatic factors the climax vegetation of a place is determined by soil or edaphic factors. The natural distribution of plant communities depends primarily on climate and secondarily on soil complex, Nine major agro-climatic zones have been recognized (see map). They are along the Western side of Sahyadri (4) and (5) along the Desh side They are:—

- (1) Mangrove belt,
- (2) Lateritic soils of Konkan,
- (3) Transitional soils adjacent to ghats on Konkan side,
- (4) Soils in ghat region having high rainfall,
- (5) Soils in the immediate vicinity of Sahyadris tolerant of high rainfall,
- (6) Soils of Maval region,
- (7) Soils in the plains with moderate rainfall,
- (8) Soils in the scarcity zone, and
- (9) Soils in high rainfall region and having mixed soils.

The transitional zone (3) on the Konkan side in the immediate vicinity of Sahyadris is not very broad. It supports poor crops, cereals like *Elucine*, *Rala*, *Niger*. The transitional zone on Desh side is some times divided into 2 parts;

- 1. Light brown soils tolerant of heavy rainfall and higher attitude such as those in Maval and Dangs regions.
- 2. Deep soils tolerant of heavy rainfall, distributed on plains having a low gradient 0.914—1.219 metres per mile. This zone is small and mostly the one where paddy is cultivated. Its major portion lies in Kolhapur, Satara, Pune and Nasik districts. Then comes the major crop producing zone of Maharashtra. It has assured moderate rainfall and plain surface extending about 400 miles long and 250 miles broad. The rainfall is about 508—635 mm and regular. Next to it there is a zone of soils either loamy or alluvial along the courses of rivers Godavari, Bhima, Krishna, Sina. Here the rainfall is about 508—635 mm (20"—25") and surface is flat, temperature high, soils deep and fertile. All these conditions are suitable for the growth of cotton and jowar. It produces best long staple cotton and high yield of jowar e.g. the Parbhani, Nanded in Marathwada area and Khamgaon in Vidarbha.

The soil situation in Khandesh and Vidarbha is different. The river Tapi descending from the ghats in Madhya Pradesh into Maharashtra has rich black cotton soil and supports all other crops in Khandesh. Tapi breaks the continuity of Sahyadris and passes into Gujarat in Navapur taluka to Ukai where a high level dam is constructed. The soils in Khandesh, therefore, are extremely fertile and have ideal conditions for cotton, bananas, sugarcane, groundnut and such other each crops.

The Vidarbha soils are formed by the Archaeans, the Vindhyans, the Gondwanas and the Traps. Vainganga, Purna and Pranahita rivers drain them. They, get both South-west as well as North-east monsoon rainfall. They, therefore, support rich monsoon forests in Melghat and Chikhaldara areas in Amravati district and Allapali forests in Chandrapur district. The Vindhyan soils of Nagpur and Bhandara districts lie in the valley of the Vainganga. They have a fair amount of calcium either as nodules (kankar), or in layers, that reduces the salinity of soils there, and helps to produce jowar and other crops. However, in areas where either salt or calcium occur in large proportion they become harmful to plant growth.

It will be seen from the above that a variety of rainfall pattern, climate and a variety of soils exists in Maharashtra. Due to them, all kind of horticultural and agricultural crops are produced and the teak forests especially in Pune, Thane, Nasik, Buldhana, Amravati and Chandrapur districts. The last one has conspicuous teak forests much prized for the figured timber of teak.

Physico-chemical characteristics of soils in Maharashtra State, and their fertility are fully dealt with in Agriculture Department Research Bull No. 21, Soil Conservation Series 9 and are given here (See Table No. I-2). Briefly stated they are as follows:—

1. The more important characteristics of soils from the view point of plant growth as the presence of major nutrients, micro-nutrients water retaining capacity and drainage, absence of salinity, alkalinity

or acidity. Most of the soils in the State are derived from the Trap except the ones in the coastal areas and in Bhandara and Chandrapur districts. The latter are derived from seaside alluvium, and in case of the former from mixed parent rocks in Bhandara district. The coastal saline soils gradually merge in the coastal alluvium wherever present. The topography largely influences their development.

- 2. Lateritic, Red bole and laterite soils.—These occur in the eastern part of Chandrapur district and have been developed under the warm humid climate under plenty of forest vegetal cover.
- 3. Coarse hill slope soils and clayey loam in the valleys.—These occur at high altitude on the mountain tops and hill slopes. They are clayey in texture or loamy. Mostly rice grows in them.
- 4. Deep and medium black cotton soils derived from Trap.—They cover the largest area of Maharashtra. They are uniform and more or less neutral or slightly alkaline in reaction. They are light, heavy or medium. There is not much difference in the surface and lower layers. They are present in Bhima, Krishna, Sina and Godavari valleys. They contain extremely favourable plant growth substances and are good for crops.
- 5. Coarse gravelly soils.—These are found in western part of Chandrapur district. They are a barad soils, very coarse in texture and have poor fertility. Only small millets grow on them.
- 6. Shallow clay loom soils.—70 per cent of the area in Bhandara district have these. They are derived from mixed parent rock materials. They are medium and have mixed origin. Rice and wheat grow on them.
- 7. Saline and alkaline soils.—These are present throughout the State where the drainage is poor, and where canal water or sea water innundate them. They are found in highly irrigated areas e.g. under Nira Canal and in the coastal area known as khar lands. Later they develop into saline soils or acid or alkaline soils.

Most of the soils in Maharashtra State contain good plant nutrients and also micro-nutrients except a few which lack manaegnese. zinc, molybdenum; but in point of NPK they are very good and by addition of corrective fertilisers and nitrogen give bumper crops. They generally have pH about 7. As examples of typical soil contents, analysis of some is given in Table No. I-3. They illustrate nature of typical soils in different regions of the State.

TABLE
CHARACTERISTICS OF SOME

Description	Medium Black Soil	Deep Black Soil	Lateritic Soil
(1)	(2)	(3)	(4)
Location	All districts Deccan Marathwad western dis of Vidarbh	and of rivers and a and streams in the stricts Trap area.	Southern part of Ratnagiri and northern part of Satara and wes- tern parts of Sangli and Kolhapur.
Parent Material	Trap	Trap	Laterite and Trap
Climate	Arid	Arid	Semi-humid
Rainfall in mm	635-762	635-762	1905-3810
Vegetation	Grass	Grass	Forest
Topography	Undulating	Flat	Hilly to undulating
Depth in metres	1 to 1.5	More than 1.5	1 to 1.5
Texture	Clay loam	Clay	Clay loam
Colour	Greyish-black	Black	Brownish red
Nitrogen (mgm) 100 gs.	40-50	50-90	150-200 (per cent)
C. N. Ratio	12-15	15-20	10-15
Hel. Soluble P ₂ O ₅ (mgm)/100 gs.	60-100	80-120	50-80
Hcl. Soluble K ₂ O (mgm)/100 gs.	150-300	200-400	80-100
Available P ₂ O ₅ (mgm)/100 gs.	10-15	15-20	Traces
Available K ₂ O (mgm)/100 gs.	15-20	20-25	Traces
Lime (CaCO ₃)	1-5	1-5	Traces
Total soluble saits	Less than 0.2	0.2 to 0.3	Nil.
Base exchange capacity (M.E.)/100 g.	30-60	70-80	15-20
Base saturation	100	100	70-80
Percentage Sodium saturation.	Less than 10	Less than 10	Less than 5
РН	7.5-8.5	8.0-8.5	5.0-6.0

No. I-2
IMPORTANT SOILS OF MAHARASHTRA STATE.

Coastal alluvial	Coastal saline	Saline Soils	Alkaline Soil
(5)	(6)	(7)	(8)
All along the coast.	Along the coast and creeks.	Scattered all over the State.	Scattered in all the soil zones and specially in deep black soil regions.
Alluvium from Trap.	Alluvium from	m Trap	
Semi-humid .	. Semi-humid	Arid	Arid.
2032-2540 .	. 2032-2540	635-762	635-762.
Tall grass .	, Sal-bush	Salt-tolerant plan	ts Alkali resistant plants
Variable .	. Flat 🦠	Flat or basin shap	ed Flat to slightly sloping
More than 1.5.	. More than 1.5	More than 1.5	More than 1.5.
Clay loam to . loam.	. Clay loam	Clay loam to cla	y Clay loam to clay.
Brown to Greyis	h Greyish black	Greyish black	. Black or brownish black.
50-60	. 40-70	40-50	. , 50-60.
15-20	. 10-12	The second second	10-12.
80-100	. 100-125	100-125	. 100-125.
100-200	, 150-200 , ,	150-200	150-200.
10-15	. 10-15	15-20	20-25.
5-10	. 5-10	15-20	. , 15-20.
1-5	. 1-5	2-6	. , 1-6.
0.1 to 0.2	. More than 3	More than 1	0.4 to 1.0.
25-30	. 30-40	60-70	50-70.

100 100 100 100.

Less than 10 .. 10-15 Less than 15 .. More than 15.

7,0-7.5 7.5-8.0 8.0-8.5 8.5-9.0.

20. CLIMATIC AND AGRO-CLIMATIC ZONES OF MAHARASHTRA

The crop pattern of a region depends upon soils and climate which means fertility of soil and effectiveness of rainfall dependent on temperature range. The agro-climatic zones of Maharashtra and crop pattern are given below.

On the basis of climate Dr. Basu (1965-70), and others recognise five climatic regions of India.

- (1) North-West India.--Comprising West Rajasthan, Punjab and Kashmir.
- (2) Central India.—This includes East Rajasthan, Gujarat, the northern divisions of Madhya Pradesh, Uttar Pradesh and Bihar.
 - (3) North-East India.—Comprising West Bengal, Orissa and Assam.
- (4) The Plateau region.—Comprising the southern divisions of Madhya Pradesh, the Deccan Plateau, Vidarbha and Chhota Nagpur.
 - (5) The Peninsular.—Consisting of coastal lands and plains.

The Desh part of Maharashtra including Vidarbha and Marathwada belongs to the 4th region above and Konkan belongs to 5th region. The nature and distribution of forests is largely governed by the ecological factors operating there, and on the nature of terrain. The agro-climatic zones on the other hand are largely dependent on the climate and soil, their nearness or distance farther from Sahyadris and Arabian sea. Since the soil is second important factor in crop production, these zones do not necessarily coincide with geological divisions of Maharashtra nor with their natural vegetational divisions. On the basis of soil and climate agronomists have divided Maharashtra into nine parts demarcating into broad agro-climatic zones (see Zende 1969). They are as follows:—

21. Broad Agro-Climatic Zones of Maharashtra

Zone 1.—Very high rainfall and lateritic soils (Chandgad, Radhanagari, Bavda, Shahuvadi talukas of Kolhapur district and the southern part of Mahad, Poladpur in Raigad district).

Rainfall 2500 mm and more max. temperature 30°-31°C, minimum 22°-24°C.

Topography-hilly.

Zone 2.—Very heavy rainfall soils not lateritic—part of Raigad district, entire Thane district, Igatpuri, Peth, Trambak and Surgana in Nasik district.

Topography—Low hills 300 m high.

Zone 3.—The ghat zone—Uneven narrow strips North to South along Sahyadris. Altitude on sea side 1000 m and about 600 m towards Desh side which is sloping. Rainfall 5000 mm. Terrain highly undulating, maximum and minimum temperatures are the lowest of all zones.

Amba, Amboli, Fonda ghat, Koyna, Mahabaleshwar, Khandala, Lonavala, Kalasubai and Harishchandragad, Akola, Bhandardara in Ahmadnagar district, Igatpuri and Trambak in Nasik district, Melghats in Amravati district.

Zone 4.—Transition Zone 1.—A narrow north-south strip lying immediately on the eastern side of the Sahyadri ranges and running parallel to them. Western hilly part of Kolhapur, Shirala, Padgaon, Patan, Medha, Velhe, Paud, Vadgaon, Khed, Ambegaon, Akola (Dist. Ahmednagar), Vani, Dindori, Trambak, Surgana, Junnar.

Rainfall is 1750-2000 mm. Crops grown—Paddy, *nagli* and niger seeds.

- Zone 5.—Transition Zone 2.—This zone runs parallel to Transition zone 1, but is much wider. It covers Pune, Kolhapur, Nasik and Ahmadnagar districts, Akkalkot taluka in Solapur district, Akrani, Taloda, Nandurbar and Sakri talukas in Dhule district. Summers and winters are warmer than in Zones 3 and 4. Soils are trap soils. It is essentially a kharif crop zone of bajri, jowar, groundnut, cotton and paddy when irrigated.
- Zone 6.—Scarcity zone.—This is the draught prone zone of Maharashtra. It includes a part of Ahmadnagar, a part of Pune, Solapur, Beed, Osmanabad, Districts, Parenda, Bhoom and Akkalkot talukas. Rainfall about 700 mm, but often less than 500 mm. Soils are calcarious, but in valleys dark, deep and grey. Kharif crops of safflower, bajri, and rabi crops like wheat, gram, jowar are grown, but there is always an uncertainty of rains.
- Zone 7.—Assured Rainfall area.—It includes major part of Akola, Amravati, Aurangabad, Osmanabad, Beed districts, and half of Parbhani district. It is bound by 700 mm isohyet on the west and 500 isohyet on eastern side. The soils are black or greyish trap soils but contain more of clay. Water gets logged in them. Topography of soil is all flat. This zone is excellent for kharif crops like jowar. Yields here are the highest in State.
- Zone 8.—Zone of moderate rainfall.—This includes the whole of Yeotmal, Wardha and Nagpur districts a part of Akola, Amravati, Parbhani and Nanded and western part of Chandrapur district. It receives 900 mm. of rain on western side and 1250 mm. on eastern side, Soils are grey or deep black, trap soils. All kharif and rabi crops grow here, especially on heavy soils.
- Zone 9.—Zone of high rainfall.—Soils derived from mixed parent rock (HRM), granites, gneisses, yellowish, brown to red in colour; coarse in texture.

This zone includes the whole of Bhandara district and mountainous parts of Nagpur and Chandrapur districts in extreme eastern region of the State. Rainfall higher than in Zones 7 and 8; about 1250 mm. Soil pH 7.2 in Bhandara district; 7.5 in Chandrapur district, Natural vegetation deciduous open forests of teak.

Crops.—Rice in kharif season and wheat, gram, linseed, some jowar in Rabi season.

TABLE No. I-3
ANALYSIS OF VARIOUS SOILS AND THEIR PROPERTIES IN DISTRICTS OF MAHARASHTRA
RATNAGIRI DISTRICT

	Av. K ₂ O (mgm.) 100g.	(10)	14.67 Percent		Av. K ₂ O (m.e.) 100g.	(12)	18	•	:		Av. K ₂ O (m.e.) 100g.	(12)	20
	Av. P ₂ O ₅ (mgm.) 100g.	6	10.29 Percent		Av. P ₂ O ₅ (m.e.) 100g.	(11)	14	:	:		Av. P ₂ O ₅ (m.e.) 100g.	(11)	13.64
	Total Nitrogen	(8)	0.13 Percent		Total Nitrogen	(10)	QN	:	:		Total Nitrogen	(01)	0.08 Percent
	Ex. Na+K (m.e.) 100g.	<u>-</u>	2.0 P.rcent	- # 	Ca Co ₃	6	32	27	20	Rона	Coastal alluvium	6	6-10
FKICT	Ex. Mg. E. (m.e.) 100g. Ex.	(9)	5.5 Percent	RAIGAD DISTRICT (1) DEEP SOILS	Ex. Na+K (m.e.) 100g.	8)	2.5	1.5	1.0	NON-LATERITIC AND COASTAL SOILS AT ROHA	Ex. Na+K (m.e.) 100g.	8	1.0
KATNAGIKI DISTRICT		_		STRICT (1)	Ex. Mg. (m.e.)100g.	6)	12	10	15	ND COASTA	Ex. Mg. (m.e.)100g.	3	13
KATA	Ex. Ca (m.e.) 100g.	(5)	8.0 Percant	AIGAD DE	Ex. Ca (m.e.)100g. ((9)	24	24	18	ATERITIC A	Ex. Ca (m.e.)100g.	9	24
	Clay	(4)	23.25 Percent	Æ	Clay ((5)	28	17	10	Non-L	Clay	(5)	27
	Silts	(3)	18.8 Percent		Silt	<u>4</u>	:	:	:		Silt	(4)	24
	Total soluble salts	(2)	0.09 Percent		T.S.S.	(3)	0.15	0.18	0.20		T.S.S.	(3)	0.26
	solu			-		(2)	6.7	7.3	0.20		Coastal alluvium	(2)	15-27
	Hd	(I)	6.7 Percent		Depth	(1)	0-20	20-40	40-70		PH	Ξ	7.5

PUNE DISTRICT

					LON	FUNE DISTRICT					
Depth	PH	T.S.S.	Silt Percent	Clay Percent	Ca Co ₃	Ex. Ca	Ex. Mg. (m.e.) 100g.	Ex. Na+K	Z Total Nitrogen	Av. P ₂ O ₅ (mgm.)100g.	Av. K ₂ O (mgm.) 100g.
(1)	3	(3)	(4)	(5)	(9)	6	8	6)	(10)	(11)	(12)
0-15	7.5	0.18	29	26	0.28	31	4	5	0.080	:	:
15-45	7.4	1.33	22	31	0.28	42	2	К	: :	:	:
45-90	7.4	1.00	12	38	0.51	46		3	:	;	:
					NAS	NASIK DISTRICT	ICT				
Hd	T.S.S.	S.	Silt	Clay	CaCo ₃	40760	Ex. Ca (m.e.)100g.	Ex. Mg. (m.e.)100g.	Ex. Na+K (m.e.)100g.	Total Nitrogen	Available K ₂ O Potash (mgm.) 100g.
(2)	(2)		(3)	(4)	(3)	V	9	6)	(8)	6	(10)
8.3	0.31 Percent		18.50 Percent	28.50 Percent	5.0 Percent	5.0 cent	35.0 Percent	9.5 Percent	2.0 Percent	0.05 Percen	25.90 Percent
					AHMADN	AHMADNAGAR DISTRICT	TRICT				
Н	T.S.S.		Silt	Clay	Caco		Ex. Ca. (m.e.)100g. (Ex. Mg. (m.e.)100g.	Ex. Na+K (m.e.)100g.	Total Nitrogen	Av. K ₂ O. (mgm.)100g.
Ξ	3	(2)	(3)	(4)	(5)	((9)	(7)	(8)	6)	(10)
8.05	<u> </u>	0.29 Percent	14.25 Percent	47.00 Percent	9.09 Percent	.09 ænt	46.05 Percent	5.50 Percent	1.05 Percent	0.06 Percent	30.40 Percent

TABLE No. I-3—contd. SATARA DISTRICT

					SAIAKA LJISINICI	BIRICI				
Depth	H4	T.S.S.	Silt	Clay	CaCO3	Ex. Ca	Ex. Mg.	Ex. Na+K (m.e.) 100g.	Total Nitrogen	Available P ₂ O ₅ K ₂ O
(1)	(2)	(3)	((5)	(9)	3	8	6)	(10)	(11)
0-30	8.9	0:30	12	48	4.5	43	10	1.5	0.042	8.0 16
30-60	8.0	0.36	6	54	4.6	37	7	3.0	Percent	Perceni
06-09	8.9	0.74	=	54	4.6	34	7	3.5	Percent	Percent
				सन्यमे	SANGLI DISTRICT	ISTRICT	JE			
Phase and Depth	Hd	T.T.S. Percent	Silt Percent	Clay Percent	CaC03	Ex. Ca (m.e.) 100g.	Ex. Mg. (т.е.) 100g.	Ex. Na+K (m.e.) 100g.	Total Nitrogen	Available P ₂ O ₅ K ₂ O (rugm.) 100g.
(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)	(10)	(11)
Shallow 0-15	7.6	0.20	16	45	2.0	37	10	:	0.03 Percent	12 16
Very deep 0-29	8.8	0.30	18	47	8.2	33	<i>L</i> .	3.5	0.07	22 20
29-59	8.8	0.49	16	20	8.9	25	8	5.5	Lence	
29-90	8.3	0.57	12	53	6.6	21	∞	5.5		
90-115	89. 89.	0.74	15		9.7	16	10	0.9		

SOLAPUR DISTRICT

Av. K ₂ O (mgm.) 100g.	(10)	14.00
Total Nitrogen	6	0.05 Percent
Ex. Na+K (m.e.) 100g.	(8)	2.5
Ex. Mg. (m.e.) 100g.	3	10.5
Ex. Ca (m.e.) 100g.	(9)	47.5
CaCO ₃	(S)	6.9 Percent
Clay	(4)	45.50 Percent
Silt	(3)	17.75 Percent
Total soluble salts	(2)	0.38 Percent
На	(1)	8.3

PARBHANI DISTRICT

Av. K ₂ O (mgm.) 100g.	(11)	12.90
Av. P ₂ O ₅ (mgm.) 100g.	(10)	8.15
Total Nitrogen	ଚ	0.04 Percent
Ex. Na+K (m.e.) 100g.	(8)	2.0
Ex. Mg. (m.e.) 100g.	6	10.00
Ex. Ca (m.e.) 100g.	(9)	41.50
CaCO ₃	(S)	5.50
Clay	(4)	27.50 Percent
Silt	(3)	21.50 Percent
Total soluble Salts	(3)	0.22 Percent
PH	(1)	8.2

WARDHA DISTRICT

Av. K ₂ O (mgm _•)100g.	(11)	25.07
Av. P ₂ O ₅ (mgm.)100g.	(01)	13.69
Total Nitrogen	(6)	0.05 Percent
Ex. Na+K (m.e.) 100g.	(8)	1.5
Ex. Mg. (m.e.) 100g.	(£)	10.3
Ex. Ca (m.e.) 100g.	(9)	45.6
CaCO3	(5)	5.9 Percent
Clay	€	41.00 Percent
Silt	3	21.50 Percent
Total soluble salts	(2)	0.25 Percent
Ы	Ξ	8.4

TABLE No. I-3—contd.
NAGPUR DISTRICT: PLACE SHIVANGAON

v. K ₂ O m.100g.) (10)	24.16		al gen		74 ent
S.) Av	L1		Total Nitrogen	(6)	0.04 Percent
(nigm. 190g.) (mgm. 100g.) (9) (10)	13.47		Ex. Na + K (m.e. 100g.)	(8)	1.0
Total Nitrogen (8)	0.05 Percent				
Ex. Na+K (m.e. 100g.)	1.5	(E)	Ex. Mg. (m.e. 100g.)	(7)	6.5
Ex. Mg. (m.e. 100g.) (6)	8.9	R DISTRICT	Ex. Ca (m.e. 100g.)	(9)	22.00
Ex. Ca (m.e. 100g.) (5)	40.0	CHANDRAPUR DISTRICT	CaCO ₃	(5)	1.9 Percent
Clay (4)	44.75		Clay	(4)	31.50 Percent
CaCO ₃	3.0		Silt	(3)	17.50 Percent
T.S.S.	0.27		T.S.S.	(2)	0.32 Percent
PH (1)	8.0		Hd	(1)	7.5

22. Forests of Maharashtra-

A forest is a plant community naturally formed or planted or both, grown mixed. The total area of Maharashtra is 3,07,183 hundred hectares of which 54,188 hundred hectares are under forests. The proportion of area under forests to the total area is 21.8 per cent. Compared to the forest area in the adjoining States it is less than that of Madhya Pradesh (39 per cent) and Orissa (43.7 per cent). In comparison to Karnatak where it is 18.41 per cent and Gujarat which has 10.4 per cent, it is more. In Maharashtra 11,192 hundred hectares are fallow lands and 13,799 hectares are grazing lands. Area under agriculture is 68.8 per cent or 30.58 crore hectares. However, not all the area under the forests is gainfully productive. On account of the peculiar geographical situation and terrain the forests in Maharashtra are mainly concentrated in the following regions:—

- (1) Chandrapur-Bhandara region at the extreme east end of the State.
- (2) In the valleys of Tapi in Khandesh having a different climatic set up and in Satpuda ranges.
- (3) The western and eastern flanks of Sahyadris, mainly in the Western ghats. Besides these, there are a few other forests representing the edaphic climax such as mangroves, beach forests, forests on riverine terraces, etc.
- (4) In Melghats the spurs of Satpudas starting from the main ranges extend eastwards on the Desh side which are mostly dry. Here only dry deciduous or scrub vegetation occurs. Some forests with stunted growth occur on the top of the ghats.

The best forests in Maharashtra are in the Chandrapur-Bhandara region and at a few places in the valleys of Sahyadris on the east and west sides, in Melghat and in low hills of Ajantha-Satmala ranges.

A natural forest is a plant community. It generally represents the climatic climax vegetation of the place. A forest represents sometimes a natural climatic climax vegetation and sometimes it does not. It may be a seral stage. The climatic climax vegetation in a particular area in its natural state primarily depends upon the climate which means rainfall, temperature range and percentage humidity during different months of the year. The natural climatic zones of the world and of forests are primarily determined on the basis of the latitude, sunshine and altitude, rainfall, humidity and temperature; secondarily on soil factors, topography. Tertiarily they are controlled or determined by the biotic factors, collectively called biota, which means effect or impact of plants on plants and of animals on plants and vice versa, and of man. They are, therefore, classified as tropical, sub-tropical, temperate, sub-temperate, Alpine and Arctic and sub-arctic. Besides these, there are deserts hot or cold tundras, prairies (grasslands), steppes, etc. This classification based on latitude does not seem to be very appropriate for the Indian conditions as we have no Alpine vegetation except in Kashmir or cold tundras or grassy steppes in India. Our high altitude forests are really the Montaine forests akin to those in Malaysia, Burma etc. As a result, the different authors have proposed different classification of the forest types such as Schimper and Chipps (1923), Davy (1936), Champion (1936), Champion and Seth (1968), Puri (1960) etc. Table I-4 below gives important views on the classification of forest types briefly

TABLE No. I-4—CLASSIFICATION OF FOREST TYPES

After Puri. (1960), (Table 25 pp. 99-101)

Brief description of the type (5)		at least lofty, tall trees, many reach 200 ft., buttressed with woody lianas; Woody epiphytes, large leaves.	It does not appear to differ sufficiently from the last named formation.	Dominants include deciduous species, but evergreen predominate.	Deciduous are the dominants and evergreens largely form the sub-dominate and lower storeys different. Top canopy tarely dense but over soft high.
Schimper and Chipp's and other classifications of tropical vegetation (4)			Subtropical rain forest; Montane; sub- It does not appear to differ sufficiently tropical forest.	Semi-evergreen Tropical semi-evergreen forest; Semi-Dominants include deciduous species, but evergreen forest; Evergreen forest; Evergreen forest; Transition forest; Mixed deciduou forest; Wet mixed forest.	deciduous Monsoon forest, Tropical moist deciduous are the dominants and he impor- randis or mixed deciduous forest, Mixed deciduous nate and lower storesy different. Top ca- nopy tarely dense but over soft high.
Champion's classification for India	<u>स</u>	ever- Wet evergreen forest (Rain Rain forest; Tro Forest).	montane Montane subtropical forest.	Tropical semi-evergreen forest.	moist includes t setona graforests, of Bomba forests an.
Burtt Davy's classification for the tropical vegetation (2)	(A) Wood land formation in the tropics. (a) Moist Wood lands in the tropics. (i) Moist climatic forma-	Tropical low land ever- green rain forest. Sub-formations:	Tropical lower montane evergreen rain forest.	Tropical Semi-evergreen rain forest.	Tropical moist deciduous forest forest. forest tant Trepical forest for
S. S.	(y)	 4		7	m

Trees evergreen, broad leaved Lianes fewer and thinner in stem; Epiphyes, harbaceous mostly cryptogams than Phanerogams with luxuriant development of epiphytic lichens or mosses.	forest. The conferous genera Widdingtonia in r forest. Nysaland and Juniperus in Kenya form an evergreen forest zone at 7,000 to 9,000.	It occurs between 7,500 and 11,000 ft on the equatorial mountains of East Africa. Arundinaria alpina dominant growing to 40 to 65 feet.	It is a belt of Alpine wood-lands not found in Maharashtra above the Tropical high montane conifer forest and the tropical montane Bomboo forest.		On water-logged alluvial soil consists of several tires, tall trees 60 to 70 high, small trees, shrubs and plants clothing the ground.
Montane wet temperate forest. Temperate Rain forest in the tropics, Broad leaved evergreen forest without conifers. Rain forest: Mountain forest, Montane stem Rain forest; Montane Wet temperate forest; Warm temperate montane rate forest; Warm temperate montane broad leaved Rain forest; Hill forest; High forest; cloud forest; Sub-tropical evergreen forest.	Montane temperate coniferous forest, forest.	Temperate Bamboo brakes	Alpine forest, Elfin-Wood, Krummhole, It is a belt of Alpine wood-lands not Sub-alpine evergreen scrub forest. high montane Conifer forest and the tropical montane Bomboo forest.	Fringing forest, Riverine forest, Moist Riparian fringing forest; Gallerie-Wald (German); Gallerie. forest (French), Riparian fringing forest; Hydrophilous fringing bush.	:
Montane wet temperate forest. Broad leaved evergreen forest without conifers.	Montane temperate coniferous forest.	Temperate bamboo brakes Temperate Bamboo brakes (Not accepted as climax.)	Alpine forests of the Himalayas	(ii) Moist edaphic forma-Riparian forest. tions. Tropical Riparion Wood-land.	Tropical fresh water swamp Tropical fresh water swamp Swamp vegetation forest.
montane	montane	ne bamboo	elfin-wood-	ohic forma- cal Riparion	water swamp
Tropical upper rain forest.	Tropical bigh conifer forest.	Tropical montane bamboo forest.	Tropical alpine elfin-wood land.	ii) Moist edal tions. Tropi Wood-land.	Tropical fresh forest.
4		9	F	<u> </u>	•

CLASSIFICATION OF FOREST TYPES—contd.

3	(2)	(3)	(4)	(5)
10	10 Tropical Palm Swamp	. Not found in India	Tropical palmgrove	Palm-groves devoid of grassy ground cover frequently occur on soils which become swampy, e. g. in N. E. F. A. and Assam.
11	Tropical mangrove wood- Tidal forest land.	Tidal forest	Mangrove, Mangrove Swamp; Tidal forest.	Tidal Below high tide mark; sometimes forest like, sometimes shruby or full of bushes.
12	Tropical littoral wood-land Beach forest, Dune forest (b) Dry Wood-land in the tropics.	Beach forest, Dune forest	Strand vegetation, Beach forest	On sandy and gravelly sea shores, not subject to immersion but under constant maritime influence, often selerophyllous.
13	Tropical dry evergreen forest	Tropical dry evergreen forest	Tropical dry evergreen forest Tropical dry evergreen forest Dry evergreen forest, Dry zone forest	Hard-leaved evergreen trees predominate under 60 to 80' high; Stocking often
7	Tropical savannah wood- land Sub-formation:	:	dense. Tree savannah; Bush savannah. Park- Xerophilous trees, deciduous, small-land; Dry forest; Tree veld; savannah leaved; top canopy light scattered short; Tockenwald (German). Impostly below 50 inches cold season rainfall less.	dense. Xerophilous trees, deciduous, small-leaved; top canopy light scattered shrubs, much tufted grass. Rainfall mostly below 50 inches cold season rainfall less
Ξ	Thorn forest	Thorn forest	:	Dense thorny bushes, thin stemmed climbers; general absence of grasses.
Ê	Savannah - thorn . Jand.	Not found in India	:	Thorny shrubs and trees predominate. Ground cover of grass and other herbs.
(iii)	Thorn scrub	Not found in India		Grass absent, succulents abundant, Thorny trees few; passs into desert.

Grass land, Savannah, Grassy Steppe, Herbaccous vegetation, Tress or shrubs, Meddows; Marsh grass land; scattered, Grasses or sedges predominate, Mountain.	Rainfall 10-20 inches or more, fairly	evenly distributed.	Sparse community, stunted trees and shrubs, annual or perennial herbs;	plants xeromorphic and succuent, Morphological type dependent on direct precipitation or on direct precipitation or on telluric moisture.	Vegetation xerophytic, less sparse than that in a true desert.	
Grass land, Savannah, Grassy Sleppe, Meddows; Marsh grass land; Mountain.	:		:	É		
:	Not found in India		Not given by Champion, but found in India.		Not given by Champion but found in India.	व जयन
(B) Grass land formations in the tropics.	Tropical grassland	(C) Desert formations in the tropics.	16 Desert vegetation		Sub-formation:	
(B)	15	<u>O</u>	16		i	

However, for all practical purposes Champion and Seth's classification (1968) is followed in forestry practice in India. However, it is necessary to state that in many places our present day forests represent not the climatic climax vegetation, but a degradation series due to human interference, soil erosion, and geophysical changes etc. They have greatly affected them and hence, they do not always represent the climatic climax. For example, when large trees in coupes in a forest are auctioned and timber trees are cut down, bamboo brakes develop and when bamboos are cut then the area is quickly covered by Lantana camara. These are degrading changes. They are quite obvious in areas where Kumali cultivation is practised or in forests below high hill forts and such places where only Lantana camara bushes are seen, due to man's interference.

The greater part of Maharashtra to the East of Sahyadris is Desh. It is dry for major part of the year and humid only in the rainy season for about 100 to 120 rainy days, rest of the days in an year are dry. The country largely depends upon the monsoons for precipitation and growth of plant, and hence the usual prayer of people of India is "Let there be timely rains and turn earth into green!" "काले वर्षेतु पज्येन्य:, पृथ्वी सस्य मालिनी!"

The climate during the rainy season is monsoonic and for the rest of the year dry or semi arid, hot or cold. Because of these climatic peculiarities, no particular system of the classification of forests can be adopted in toto. It has to be accepted with some modification and certain limitation. Champion and Seth (1968) whose system is generally followed have classified the Indian forests into 18 climatic forest types as follows:—

I. Tropical West Evergreen Forests:

Annual mean Temperature ... 27.2°C | Annual Rainfall ... 3292mm. Annual Humidity ... 77 percent | At Mangalore.

Here the trees form forest canopy, multilayered, evergreen trees more than 45 m. high with numerous epiphytes, but climbers only a few. This is found on the Western face of the Western ghats in small pockets in valleys. The constituent trees are Mesua ferea, Dysoxylum, malabaricum, Calophyllum inophyllum, Artocarpus sp., Hopea wightiana Syzyqium cumini.

II. Tropical Semi-Evergreen Forests:-

Annual mean Temperature ... 26.3°C
Annual Rainfall ... 3606 mm.
Annual Humidity ... 80 percent

Forest high with large tall trees, close. Deciduous trees often have buttressed trunks with thick woody climbers, epiphytees abundant, bamboos infrequent. This type does not occur in Maharashtra. The trees here are Artocarpus hirsuta, Lagerstroemia lanceolata, Anthocephalus kadamba, Dalbergia latifolia, Terminalia tomentosa, Adina cordifolia, Pterocarpus marsupium, Holopetelea integrifolia.

III. Tropical Moist Deciduous Forests:-

Annual mean Temperature .. 27·10°C
Annual Rainfall .. 1324 mm.
Annual Humidity .. 56 per cent

At Chandrapur.

This type occurs throughout the moist part of Maharashtra, Gujarat, Madhy Pradesh, Mysore etc. Top storey of vegetation predominantly of deciduous species, irregular, trees 40 m. or more high heavily buttressed. Second storey of predominantly deciduous plants mixed with some evergreens. Undergrowth shrubby, climbers dense; canes and many Bamboos grow in places as undergrowth. This is the main type that is seen in Allapalli forests of Chandrapur.

Trees occurring here are Tectona grandis, Semecarpus anacardium, Salmalia malabarica (Silk co ton tree or Semul), Lagerstroemia parviflora, Xylia xylocarpa, Grewia tiliaefolia, Terminalia paniculata, Schleichera trijuga, Embelica officinalis and Dendrocalamus strictus.

IV. Littoral and Swamp Forests:-

Annual mean Temperature ... 27.9°C
Annual Rainfall ... 1042 mm.
Annual Humidity ... 73 per cent
Andhra Pradesh.

These consist of evergreen species with variable density and height of trees. They occur near sea coast, estuaries and river deltas. Temperature here being constant and rainfall abundant, there is great humidity throughout the year. Mangroves of Raigad, Thane, Greater Bombay, Ratnagiri, Chiplun, Terekhol in Sindhudurg district belong to this.

Littoral forests:—They represent edaphic climax. They have some small evergreen and some deciduous trees. Surface creepers like Ipomoea biloba and maritime grass Spinifex sguarasa abundant in areas where fresh water is available. Tall grass Phragmites occurs at some places on Malvan, Vengurla coast.

Mangrove scrub and strand plants:—This forms dense growth on muddy coastal flats and river deltas. Sonneratia apatala, Agiceras majus, Avicenia officinalis Acanthus, ilicifolius grows mixed with creepers of Tylophora indica. Behind these there are tropical riverine forests fringing the river banks at Janjira, (Murud), etc. By Lagerstroemia parviflora, Terminalia arjuna, Salix tetrasperma, Premna asiatica.

V. Souhern Tropical Dry Deciduous Forests:-

Annual mean Temperature ... 27.3°C Annual Rainfall ... 825 mm. At Nagpur.

These consist of a number of mostly deciduous species. They dry up in summer months. Their upper canopy is not close. Trees are generally 20 m high. Different species predominate in different areas, but they are not gregarious, heterogenous. The canopy having been made up of deciduous small trees, or tall shrubs permitting light to reach the forest floor where good grass grows. Climbers are few. Some like Entada pusaetha are large and woody. Bamboos are present. A few epiphytic ferns and orchids occur. This type is abundant throughout the Western region of Maharashtra and other parts of the Western ghats.

Tall Teak Forests.—Here dry deciduous species such as Terminalia tomentosa, Adina cordifolia, Schleichera trijuga occur with Tectona grandis which is the main species. It occurs also in Madhya Pradesh in Bastar area and in parts of other States adjoining Maharashtra.

Southern moist mixed Deciduous Forests.—They are common in ghat section and in Chandrapur area. Terminalia bellerica, Pterocarpus marsuipium, Salmalia malabarica Anogeissus latifolia, Dalbergia sisoo, D. latifolia occur in plenty.

Southern Dry Mixed Deciduous Forests.—They are formed by Boswelia serrata, Bamboos, Bauhinia vahlii, Acacia torta and A leucophloea. Rainfall is 975-1500 mm. They occur on well drained hill sides and are very common in Bhandara district. The trees are: Terminalia tomentosa, Lagerstroemia parviflora, Soymida febrifusa, Anogeissus latifolia, Acacia catechu, Emblica officinalis, Zizyphus xylopynes, sweitenia, Ougeinia oojeinesis, Lannea grandis, Woodfordia fruiticosa, Helicteris isora, Nyctanthes orbor tristis, Dendrocalamus strictus. The forests near Chaturshringi at Pune and Katraj belong to this type. Santalum album, Gymnosporia montana, Gymnosporia spinosa, Osyris wightiana, Rhus mysorensis, Acacia leucophloea, a few plants of Cochlospermum gossypium and Stereospermum personatum, Dolichandrone falcata occur here, besides various grasses. The area has some deciduous trees as in dry deciduous forests and some species go to form a thorny scrub. Because of these the forests at Chaturshringi are considered to be regressive sere of a mixed deciduous forest.

Dry Deciduous Scrubs.—These grow generally on poor shallow soil with shrubby growth below 3000' height. Some Bamboos are always present in it. Randia dumetorum, Carissa carandas bushes of Dodonia viscosa and Zizyphus rugosa are commonly found.

Dry Grassland.—Here Schima nurvosum, Heteropogon contortus, Dichanthium annulatus. Themeda triandra are abundant on hills near Kalyan. These grasslands often get deteriorated. The leafy fodder grasses get replaced by annual woody ones, especially by Heteropogon contortus, Aristida histrix, Eragrostis aspera and Symbopogon martini.

Various edaphic climax types of dry deciduous forests are known, e.g. *Babhul* forests between Daund and Pune. *Hardwickia binata* forests between Malegaon and Dhule, bamboo brakes in Melghat are some examples. They indicate secondary succession.

Babhul or Babul Forests.—Acacia arabica grows markedly gregariously. Undergrowth is very little and grass cover is thin for grazing. The original type is much altered due to grazing. A similar type with Balanites roxburchii, Acacia leucophloea, Prosopis spicigera, Azadirachta indica, Casearia grandis, Butea monosperma form a similar degraded forest series from dry deciduous forest in Vidarbha, Marathwada Hills, Kinwat etc. These are much altered forest areas due to may's interference.

VI. Tropical Thorn Forests:-

Annual mean Temperature 27.0°C

Annual mean Rainfell ... 691 mm.

Annual mean Humidity ... 47 %

This is a low open xerophytic forest containing thorny leguminous plants. Trees have low branches and short boles. Lower storey consists of xerophytic bushes and spiny shrubs such as Acacia torta, Azadirachta indica (Neem), Phoenix sylvestris, Butea monosperma (Palas) which predominate.

VII. Tropical Dry Forests:-

Average mean Temperature 27.9 ° C Average mean Rainfall . . 1052 mm. Average mean Humidity . . 74 per cent

This is a low forest type having trees 12 m high. They have short boles and rather small, coriaceous leaves. There is no differentiation of layers. Bamboos are very rare. Growth is not sparse. This type is restricted to a small coastal area adjoining Sawantwadi, Goa and Karnatak.

VIII. Western Sub-tropical Broad-leaved Hill Forests:-

Annual mean	Temperatu	ire	21.4 ° C	`)
Annual mean					> Panchmadhi
Annual mean	Humidity		57 %	٠	j

The species here are Actinodaphne hookeri, Memecylon umbellatum, Randia dumetorum, Flacourtia latifolia, Terminalia chebula, Olea dioica, Glochidion hohenackeri, Pouteria tomentosa, grasses like Dicanthium, dicocium, bushes of carvia callosa, Scutia myrtina, Pogostemon plactranthoides, Lasiosiphon eriocephallus, Elaeagnus latifolia, Allophyllus cobbe, Capparis pedunculosa, Zizyphus rugosa, Pavetta indica etc.

IX. Sub-tropical Pine Forests :-

This type is found through out NW Himalayas at an altitude of 1000-1800 m. It is common in Khasi, Manipur and Naga Hills. It does not occur in Maharashtra.

X. Sub-tropical Dry Evergreen Forests:-

This is practically a low scrub formed by small evergreen trees and shrubs and thorny bushes. Herbs and grasses appear in monsoons only. This type is common in Siwalik hills in NW Himalayas.

XI. Montane Wet Temperate Forests :-

This type, with trees 6 m or less high have large bole, spreading branches dense crown. Leaves are generally coriaceous. Branches are abundant clothed with mosses, ferns and other epiphytes. Climbers are woody. They are common in the hills of Madras and Kerala about 150 m high and in higher hills of Bengal, Assam, NEFA in Eastern Himalayas from 1800-3000 m. but absent in Maharashtra.

XII. Himalayan Moist Temperate Forests :--

These are purely of conifers 30-50 m high, mostly with evergreen species.

Mosses and ferns grow abundantly on tree trunks. It is found throughout Himalayas in Alpine and Sub-Alpine regions of Kashmir, Himachal Pradesh, Punjab, U. P., Darjeeling, Sikkim between 1500-3300 m at Chakarata (U. P.), in Sutlej valley in Himachal Pradesh. This is absent in Maharashtra.

XIII. Himalayan Dry Temporary Forests :--

These are coniferous forests, but have a mixture of xerophytic shrubs in them. Some epiphytes and climbers occur in them. SW Monsoon here is weak, less than 100 mm. It occurs abundantly in Ladakh, Gadhwal and Sikkim, but absent in Maharashtra.

XIV. Alpine Forests :-

The Alpine forest types occur at 3000-4000 m in Himalayas. In sub-Alpine type small conifers and large shrubs occur nearly at the upper limit of the tree line in Himalayas, adjacent to Alpine scrub and grassland in the Kulu valley. Main species belong to Larirx, Rhododendron and Taxus baccata, Picea excelsa. It is not present in Maharashtra.

XV. Moist Alpine Forests :--

This type occurs throughout Himalayas above 3000 m. They have dense growth of low evergreen *Rhododendrons*, bushes of *Berberis*, *Betula* (Birch) etc. Mosses, ferns, honeysuckle (*Lonifera*), a few flowering herbs grow commonly as undergrowth. This is not present in Maharashtra.

XVI. Dry Alpine Scrub:

This occurs at the uppermost limit of xerophytic scrub formed by dwarf shrubs above 3500-4000 m in the Himalayas. Species of *Juniperus*, *Artemesias*, *Potentilla*, and *Lonifera* occur here. This is not found in Maharashtra.

XVII. West Coast Semi-evergreen Forests :-

These occur between wet evergreen and moist deciduous forests in small narrow strips. They are much altered due to biotic factors operating in Western Ghats. Species found here are Terminalia paniculata, Diospyros assimilis, Alycicarpus seratus, Lagerstroemia lanceolata, Holigarna arnottiana, Cinnamomum tamala, Hopea parviflora, Mallotus philippensis and large climbers of Anodendron paniculatum and Entada pusaetha, Calamus pseudotenuis, Vitex negundo, Kydia calycina, Terminalia belerica, Elaeodendron seratus, Glycosmis pentaphylla, Bambusa arundinacea.

XVIII. Lateritic Semi-evergreen Forests :--

These consist of Xylia xylocarpa, Anogeissus latifolia, Grewia tiliaei folia, Terminalia sp., Careya arborea, Bridelia retusa, Calycapteris floribunda, Strychnos nux-vomica, Leea macrophylla, Adhatoda vasica, Holarrhena antidysentrica and occasionally Grewia nudiflora.

It will be seen from the above that from among the 18 forest types characterised by Champion and Seth (1968), not all occur in Maharashtra. The types listed below occur in Maharashtra:—

- 1. Tropical Wet Evergreen Forests
- 2. Tropical Semi-Evergreen Forests
- 3. Tropical Moist Deciduous Forests
- 4. Tropical Dry Deciduous Forests
- 5. Tropical Thorn Savannah.
- 6. Tropical Edaphic Forests.

These mainly consist of lateritic ghat forests of dry trees such as Hardwickia, binata Memeceylon edula, Butea monosperma. Acacia arabica, Capparis horrida and such other species

- 7. Littoral Zone Forests (Mangroves and Beach forests). These are Tidal zone forests in fresh water and marshy swamps.
- 8. Broad or small-leaved forests of Montane types: All these forests are not economically important though ecologically they are important in maintaining the vegetational balance. Champion and Seth (1968) recognise various sub-types in each. Bamboo and cane brakes are generally considered to be of secondary origin due to breakdown of a Dry Deciduous forest; and as such, they present several stages in the breakdown of Dry Deciduous Forests.

Consideration of their vegetation, ecology, products and productivity is important.

All these forest types are distributed in different Forest Divisions of the State described later. The predominant type on Desh side is Dry Deciduous Forest, which is ecologically and economically the most important. It has been present in the Deccan Trap country since Eccene period. Its origin is considered to be from evergreen forests by Mahabale (1979), Meher Homji. The evolution of them is generally believed to be as follows:—

Evergreen forests, Semi-evergreen forests, Moist deciduous forests, Dry deciduous forests, Scrub or open temporary grass lands of animal forage grasses.

All these forests are useful for the vegetal cover of Maharashtra, but only some of them are economically important. In these the Dry deciduous Teak forests are the most important and so are the open grass lands. If the conditions of temperature and rainfall are more favourable Dry Deciduous Forests could revert to semi-evergreen type. Flora of these forests has been briefly described by Querishi (1962). Recent finding of Meher Homji (1980) on forests of West coast in Maharashtra, Karnatak and Kerala is that deforestation on large scale shows a trend of decreasing rainfall.

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CHAPTER II

GENERAL SURVEY OF DIFFERENT PLANT GROUPS IN MAHARASHTRA—THALLOPHYTA

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CHAPTER II: GENERAL SURVEY OF DIFFERENT PLANT GROUPS IN MAHARASHTRA—THALLOPHYTA

The total number of plants in the world is very large, consisting of over two lakhs of flowering plants and nearly two lakhs of plants without flowers. To know such an enormous number of plants it is necessary to devise some sort of classification of them. Various authors since the days of Aristotle (584-323 B.C.) to the days of Linnaeus (1707-1778), and to the present times have devised various systems of classification. The one which is largely accepted is the system of Eichler (1875-1878) which is as follows:—

A. Cryptogamas-

Division I—Thallophyta
Class 1—Algae
Class 2—Fungi
Division II—Bryophyta
Division III—Pteridophyta

B. Phanerogamas—

Division I—Gymnosparmae
Division II—Angiospermae
Class 1—Monocotyleae
Class 2—Dicotyleae

To the classes of Thallophyta, above one more Class was added later namely Lichens.

The classification of these plants given by Smith (1938) and others is as follows—

THALLOPHYTA BRYOPHYTA PTERIDOPHYTA GYMNOSPERMAE ANGIOSPERMAE

CRYPTOGAMIA

THALLOPHYTA
A. ALGAE
EUGLENOPHYTA
PYROPHYTA
CRYSOPHYTA
CHLOROPHYTA
PHEOPHYTA
RHODOPHYTA
CY NOPHYTA

Thallophyta are distinguished by their simple undifferentiated plant body, one-called gametes, or multicellular spore-containing bodies. Sex organs of Thallophyta are extremely simple. Their gametes are not surrounded by a sterile layer or jacket of cells constituting the antharidial and archegonial cover, unlike that in the Pteridophyta or Bryophyta. Sporangia of the Thallophyta are always one-celled as against multicelled sporangia of higher plants. The zygote does not develop into multicellular embryo while within the female reproductive organ. It is customary to recognise three large Classes of Thallophyta: the Algae, the Fungi, and Lichens. The terminology used to denote the various groups among them is varied. The terms used are Chlorophyta, Cyanophyta, Phaeophyta, Rhodophyta etc., or the Chlorophyceae, Cyanophyceae, Phaeophyceae and Rhodophyceae. However, in keeping with the modern trend we shall use terminology for different groups with the suffix 'phyta' to denote each category without entering into theoretical discussion as to whether the term used constitutes a division or a Class. According to this, Algae, Fungi and Lichen would constitute three distinct equivalent sub-divisions of Thallophyta. Algae comprise following five classes:

SECTION A-ALGAE

In this Class Chlorophyta plants, are green like grass, possessing chlorophyll, Chlorophyll a and b, Carotene and Xanthophyll. They are the same as in higher vascular plants and are in the same proportion as in them. They are localised in the form of definite plastids, the chloroplasts. They generally form starch as the chief product of photosynthesis. Their body may be unicelled or multicelled, their reproductive cells have generally two; sometimes four, flagella or cilia at their anterior end and as a rule are of equal length. Reproduction may be sexual or asexual. The sexual cells or gametes are produced within the unicellular sex organs. The fusing gametes may be of equal or unequal size. Asexual reproduction may take place by zoospores.

There are 360 genera and 5700 species of Chlorophyta. Majority of them are fresh water plants, others are marine. The fresh water Chlorophyta are rather small; marine forms are large, easily seen with naked eyes. They make the following families and their relationship is indicated by Smith (1938) as shown in diagram on p. 59.

I Chlorophyceae (Isokontae)

II Xanthophyceae (Heterokontae)

III Chrysophyceae (Chrysoe = golden yellow algae)

IV Bascillariphoyceae (Diatomaceae).

Kieselghur or silicious ooze containing many diatoms (Kiesel means silica or sand)

V Cryptophyceae (Cryptos=minute)

VI Dinophyceae (Peridineae)

VII Chloromonadineae

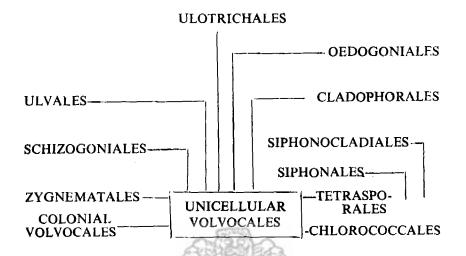
VIII Eugleninae or unicellular lower flagellate organisms.

IX Phaeophyceae or Brown Algae (Paias = dusky, Phykos = Sea = weed)

X Rhodophyceae or Red Algae (Rhodon = Rose)

XI Myxophyceae or Blue green Algae (Cyanophyceae, Kyanos=blue)

The classification of entire algae given by Smith (1938) is quite elaborate and is given below. The inter-relationship of the Chlorophyta is indicated by the following diagram:



Smith's Classification of algae

I. CHLOROPHYTA

Class 1-Chlorophyceae

Order 1-Volvocales

Family 1—Chlamydomonadaceae

Family 2—Volvocaceae.

Order 2—Tetrasporales

Family— Tetrasporaceae

Order 3- Ulotoichales

Family 1—Ulotrichaceae

2-Microsporaceae

3—Cylindrocapsaceae

4—Chaetophoraceae

5—Protococcaceae

6—Coleochaetaceae

7—Trentepohliaceae

Order 4-Ulvales

Family 1—Ulvaceae

2-Schizomeridaceae

Order 5-Schizogoniales

Family - Schizogoniaceae

Order 6-Cladophorales

Family 1—Cladophoraceae

2-Sphaeropleaceae

Order 7—Oedogoniales

Family - Oedogoniaceae

Order 8—Zygnematales

Family 1—Zygnemataceae

2-Mesotaeniaceae

3—Desmidiaceae

Order 9-Chlorococcales

Family 1—Chlorococcaceae

2-Endosphaeraceae

3-Characiaceae

4-Protosiphonaceac

5-Hydrodictyaceae

6—Oocystaceae

7-Scenedesmaceae

Order 10-Siphonales

Family 1—Bryopsidaceae

2-Caulerpaceae

3-Halicystaceae

4—Codiaceae

5—Derbesiaceae

6-Vaucheriaceae

7-Phyllosiphonaccat

Order 11—Siphonocladiales

Family 1-Valoniaceae

2—Dasycladaceae

Class 2—Charophytaceae

Order-Charales

Family-Characeae

II. EUGLENOPHYTA

Class—Euglenales

Order 1-Euglenales

Family-Euglenaceae

Order 2—Colaciales (Euglenocapsales)

Family-Colaciaceae

ALGAE 61

III. PYROPHYTA

Class 1—Cryptophyceae

Order—Cryptophycales

Family—Cryptaphyceae

Class 2-Dasmokontae

Class 3—Dinophyceae

Order 1-Gymnodiniales

2-Peridiniales

3-Dinophysidales

4-Rhizodiniales

5—Dinocapsales

6-Dinotrichales

7—Dinococcales

IV. CHRYSOPHYTA

Class 1-Xanthophyceae

Order 1-Heterochloridales

2-Rhizochloridales

3—Heterocapsales

4-Heterotrichales

5—Heterococcales

Class 2—Chrysophyceae

Order 1—Chyrsomonadales

Sub-order 1—Cromulineae

Sub-order 2—Isochrysidineae

Sub-order 3-Ochromonadineae

Order 2—Rhizochrysidales

3—Chrysocapsales

4—Chrysotrichales

5—Chrysosphaerales

Class 3—Bacillariophyceae

Order 1—Centrales

2—Pennales

Very simple among the Green algae are the Volvocale. They may be unicellular or multicellular, coenobial or filamentous. Several species of Volvocales are known to occur in Maharashtra. They grow in fresh water ponds, tanks, rivers, temporary pools, below cascades, on moist soil or in marine waters. Apte (1936) has described Volvox cartari, V. poonaensis from Pune and Purandar.

The marine forms are large and multicellular. Unfortunately in Maharashtra even a complete check-list of fresh water algae is not available. It is extremely difficult therefore to put even an approximate number of genera and species of fresh water algae with confidence. The one prepared and described by K. P. Biswas (1949), for India is the only list available, though incomplete and out of date at present. There are 11 Orders of the Green algae. Very simple among these are the (1) Euglenales, (2) Volvocales, (3) Unicellular Chroococcales, Charales are highly evolved.

1. CHLOROPHYTA

Chlorophyta are Green Algae having the same pigments as in higher plants. Their classification by West (1916), Fritsch (1948) and Smith (1938) is largely followed.

West (1916) has recognized four primary divisions of Chlorophyceae. (1) Isokontae, (2) Heterokontae, (3) Akontae, and (4) Stephnokontae. Fritsch (1944) however, recognises 11 classes of algae. The Chlorophyceae is the first one in his System. Chlorophyceae (Isokontae) comprises families Volvocaceae, Hydrodictyaceae, Chlorellaceae, Scenedesmaccae, Ulorotrichaceae, Trentepholiceae, Cladophoraceae, Oedogoniaceae, Vauchariaceae, Conjugateae or family Zygnemataceae, Desmidiaceae and Characeae.

Xanthophyceae (Heterokontae) constitute the second group of the Chlorophyceae. It includes families Tribonamaceae, Botrydiaceae. The third group comprises the family Bacillariophyceae or Diatomaceae, the fourth Dinophyceae and the fifth Euglenaceae.

Since different authors follow different systems, the one by Fritsch (1944) and Smith (1938) would largely be followed here. A number of papers on different members by workers like Majeed, Allen, Bharadwaj, Biswas, Boergessen, Bruhl, Carter, Dixit, Ghose, Iyengar, Hobson, Mitra, Parukutti, Ramnathan, Randhawa, C. B. Rao, R. N. Singh, Thivy, Apte, Gonzalves, Kamat, Gandhi etc., have appeared. However, there is no consolidated list of green algae in India. Only monographs dealing with Cyanophyta by Deshikachari (1959) and Zygnamatales by Randhawa (1959), Characeae by Pal et al (1962) are available. The lists given here therefore should not be considered as complete. It is only indicative of the wide range of the members of different families of this group that occur in India due to variety of habitats. They demand further investigation.

Professor M. O. P. Iyengar (1928) has described and added largely to our knowledge of this taxon. Family Volvocales in Bombay Presidency has been described by Apte (1936). A very characteristic Algae of India Drapanaldiopsis indica, has been described by Y. Bharadwaj (1938) and Mitra (1943), and the second, Fritschiella tuberosa, by Iyengar (1932) and R. N. Singh (1941). Since then much work has been done on the cytology of algae in the Botany Department of the Banaras University by Sharma (1971) and others at Madras University and at Poona University and Institute of Science, Bombay; but there is no composite account of them. Therefore, only the selected members have been mentioned below.

सत्यमव जयन

Family I Volvocaceae—Apte (1936) has described Volvox dissipatrix Shaw, Volvox prolificus Iyengar, Volvox carteri Stein (V. globator Stein), Volvox poonaensis Apte. Volvox carteri occurs also in Bombay and Volvox poonaensis in Poona. Some other species are common throughout the State.

Family II. Chlorococcaceae for India have been described by Iyengar (1920). The common genus is *Chlorococcusm*.

Family III. Ulotrichaceae—Ulothrix zonata, common.

Family IV. Cladophoraceae—In this family marine and fresh water forms are found, more fresh water than marine. The common members such as Cladophora glomerata, Chaetomorpha, Rhizoclonium are common. In fresh water Cladophora crispata, Pithophora sp. Cladophora and Pithophora have both fresh water and marine species.

Family V. Chaetophoraceae—Common genera are Chaetophora and Pleurococcus.

Family VI. Oedogoniaceae.

A large number of species both monoeceous and dioeceous occur in the country. But they have not been monographed. Of the other two genera, Bulbochaete is known to occur in moving river like Mutha and streams; and Oedocladium on moist soil at hill stations. Bulbochaete elatior is common in many fresh water streams and rivers. The common species of Oedogonium are Oedogonium terrestris, Oedogonium sociale, and Oedogonium oblongatum. Of these three genera, Oedocladium is rare. This interesting alga is found generally at hill stations above 3000' altitude.

In Conjugateae or Zygnemaceae the common genera are (1) Debarya, (2) Temnogamatum, (3) Mougeotia, (4) Gonatonama, (5) Zygnema, (6) Zygogonium, (7) Pleurodiscus, (8) Pyxispora, (9) Spirogyra, (10) Sirogonium, (11) Gonatozygae, (12) Spirotaenia, (13) Closterium, (14) Cosmarium. Temnogametum is very rare.

The members of this family occur generally in the post monsoon period in ponds or rivers, in which they grow till summer. They grow through winter and sometimes in spring and sprout again from zygospores, aplanospores, or akinetes next rainy season. A few are ephemeral, e. g. Mougeotia sphaerocarpa, Spirogyra dacdalea. They propagate by spores throughout the year. The following Table No. II-1 shows species which generally occur in Maharashtra and Western India:

TABLE No. II-1

Name	Habitat	Remark
(1)	(2)	(3)
Family Mougeotlacea		
1. Debarya jogensis Iyengar	Known from Saravati falls in rock- pools in the bed of river of Saravati River above Raj falls (Karnatak).	
2. Temnogametum indicum	In Nal sarowar in Western Gujarat in rocky pools, but unknown as far in Maharashtra.	
Family Zygnemacaceae	1	
3. Zygnemopsis saravatiensis	Above Jog falls in rocky pools in the beds of Saravati river (Karnatak). Not known in Maharashtra.	
Zygnema stellinum (Vaucher) Agardh.	Free floating in the beds of river and rocky pools, Bombay, Pene, Nasik.	
Zygogonium hansgirgii (Schmidle) Transeau.	Igatpuri either terrestrial or sub- aerial—generally near water streams.	
Zygogonium aricetonum Kutz,	Western ghats on laterite soils on hill slopes and open ground.	

TABLE No. II-1-contd.

Name	Habitat	Remark
(1)	(2)	(3)
4. Family Spirogyraceae		
Spirogyra microspora Jao	Ghatkopar, Bombay.	
Spirogyra indica Krieger	Central Provinces	
Spirogyra rivularis (Hussoll) Rabenhorts.	In running water near Kanheri Caves, Bombay.	
Spirogyra turtusa Gay	In puddles at Vile Parle, Bombay	
Spirogyra hymerae Britter and Smith.	Puddles at Khar, Bombay.	
Spirogyra ellipsospora Transeau.	Streams near National Park, Bombay, Kanheri caves.	
Spirogyra trip!lcata (Collins) Transeau.	In a pond at Khar, Bombay.	
Spirogyra punctulata Jao	In a stream near National Park, Bombay.	
Spirogyra dictyospora Jao	In a stream near Borivli.	
Spirogyra ori ntalis W. and G. S. West.	In a stream near Dahisar, Bombay.	
Spirogyra braziliensis (Nordst) Transeau.	In puddles at Goregaon, Bombay.	
Spirogyra quadriaminata Jao	In a pond near a temple at Thane, Bombay.	<u> </u>
Spirogyra rhizobrachialis Jao	Near a streamlet near Kanheri caves, Bombay.	
Spirogyra minor (Schmidle) Transeau.	In a puddle at Vile Parle, Bombay.	
Spirogyra verrucasa (Jao) Krieger.	Central Provinces.	
Spirogyra apulata Jao	In a puddle at Koliwada, Bombay.	i
Spirogyra majuscula Kutzing	In a puddle at Koliwada, Bombay.	
Spirogyra punctiformis Transcau.	In a puddle at Goregaon, Bombay.	
Spirogyra micropunctata Transeau.	Streams at Borivli.	
Spirogyra arta Jao	Bombay.	
Spirogyra tumida Jao	In a puddle at Goregaon.	
Spirogyra denticulata Transeau.	In a pool at Andheri, Bombay.	
Spirogyra kuusamoensis Hirn	Bombay.	
Spirogyra gravilleuna (Hussali) Kutzing.	Dahisar, Bombay.	

TABLE No. II-1-contd.

Name	Habitat	Remark
(1)	(2)	(3)
Spirogyra faoi Ley	In a pool at Andheri, Bombay.	
Spirogyra inconstans Collins	In a streamlet near Kanheri caves, Borivii, Bombay.	
Spirogyra moehti Transeau	Bombay.	-
Sirogonium ceylanicum Wittrock,	In rainwater poels in Bombay,	
Sirocladium Maharashtranse Randhawa.	Terrestrial on wet fields at Khandala, Katra, Western ghats, Bombay.	
umily Ulvaceae*		
6. Enteromorpha flexuosa (Wolf).	Bombay	Marine.
Enteromorpha tubulosa Kutz	Bombay.	
Enteromorphu prolifera (Fi. Dan.) J. Ag.	Bombay	Marine.
7. Ulva lactuca L	Bombay.	Marine.
(Ilva reticulata Forssk	Bombay.	Marine.
Family Boodleaceae*	7014848	
8. Cladophoropsis zollingeri (Kutz) Boergs.	Bombay.	Marine.
Cladophoropsis sundanansis Reinbold.	Bombay.	Marine.
Family Cladophoraceae	सन्यम्ब जयत	
9. Rhìzoclonium kochianum Kuetz.	Bombay.	
Rhizoclonium grande Boergs	Bombay.	
10. Chaetomorpha indica Kuetz	Bombay.	
Chaetomorpha Linoides (Ag.) Kuetz.	Bombay.	
Chaetomorpha aerea (Dillwa) Kuotz.	Bombay.	
Chaetomorpha antenuiana (Fory) Kuetz.	Bombay.	
Chaetomorpha clavata (Ag.) Kuetz.	Bombay.	
11. Lola (?) capillaris (Kuetz.) A, et G. Hamel.	Bombay.	
12. Cladophora saracenica Boerga	Bombay.	}
Cladophora colaxbense Boergs	Bombay.	1

TABLE No. II-1-contd.

Name	Habitat	Remark
(1)	(2)	(3)
Cladophora bombayensis . Boergs.	Bombay.	Marine.
•	Bombay.	Marine.
Family Dasycladiaceae Boergs		
13. *Acetabularia calyculus Quo et Gaimard.	Bombay.	Marine.
Family Siphonocladaceae		
14. Struves delicatula Kuetz .	. Bombay.	
Family Bryoesidaceae		
15. Pseudobryopsis mucronata	Bombay.	
Family Caulerpaceae	Section	1
16. Caulerpa fastigiata Mont.;	. Bombay.	Marine.
Caulerpa scaepelliformis vai intermedia, Web.	Bombay.	Marine.
Caulerpa racemosa (Forsk) Web. V. Bose.	Bombay.	Marine.
Caulerpa peltata Lamour .	Bombay.	Marine.
Family Vaucheriaceae		
17. Vaucheria piloboeoides Thu	r Bombay.	
	सन्यमेव जयते	

*These are marine.

The affinities and the inclusion of some genera of green algae in one family or the other is often controversial.

In Eugienales Euglena and Chlamystomonas are the chief representatives of unicellular Green algae. They have colourless or green coloured protoplasts. Euglenales are taken by some as a separate Order of the Chlorgphyta called Euglenophyta, Family—Euglenaceae. Similarly the Dinoflagellates are considered to be members of animal kingdom by the zoologists, and as plants by the botanists. Their fossils occur in the Tertiary oilbearing strata in Gujarat. The diatoms are also green coloured unicellular organisms. They are put in a separate group Bascillariophyta, family Bascillariaceae. They have lamillate protoplast with one or more pyrenoid bodies. Their cell wall is highly silicified. It presents numerous patterns which make their identification and classification easy. They are of two types: the Centrales and Pinnatales, or Pinnales.

Another conspicuous group in fresh water is the Charales characterised by erect branched thallus divided into nodes and internodes. The branches with limited growth—the so-called leaves' form a whorl at each node. They bear either one-celled solitary oogonium surrounded by a sheath of spirally arranged sterile cells at a node. Antheridia

also are one-celled, but are united in uniseriate filaments surrounded by a common round envelope of 8-celled manubrium around a stalk. There are 6 genera and 85 species of Charales. Some species of past Charales have been found in the Deccan Intertrappean Series and are recognised by the spirally covered outer cells on the oogonium or the nucule. They are called 'Gyrogonites'. About a dozen species of them have been recognized. The other two genera have rather smooth walls and are small plants. They are known as Nitella and Lamprothamnium. The former only occurs in Maharashtra. Charales prefer clear aerated water.

Charophyta in Maharashtra

The Charophyta are represented by two genera, *Nitella* and *Chara* in Maharashtra. They have been mainly studied by S. C. Dixit (1935, 1940, 1942). The chart below shows the species occurring commonly. A careful and intensive search if made in Western Ghats may yield some more.

They also occur in fossils in Deccan Intertrappean beds at Sansar and other places. This shows the great antiquity of this group in Maharashtra.

List of Charophyta in Western India

Genus Nitella-

- 1. N. apaca Agardh
- 2. N. acuminata Braun
- 3. N. stellaris Allen T. F. Dixit.
- 4. N. dualis Nordstadt
- 5. N. confervacea A. Braun
- 6. N. oligospira Braun
- 7. N. furcata Agardn
- 8. N. mucronata (Br.) Muquel
- 9. N. tenuissima (Desv.) Kutz var. bryssoides Braun
- 10 N. translucens Agardh
- 11 N. hyalina (DC) Agardh

Genus Chara-

- 1. C. corallina Willdenov
- 2. C. brauni Gmelin
- 3. C. contraria Kutz.
- 4. C. succinata Braun
- 5. C. nuda Pal var. Kolhapurensis Dixit
- 6. C. fibrosa Agardh
- 7. C. hatei Dixit
- 8. C. contraris Kuetz
- 9. C. vulgaris Linn.
- 10. C. globularis Thailler
- 11. C. brachypus Braun
- 12. C. zexlanica Willd.

2. BACILLARIOPHYTA

Fam. Bacillariophyceae or Diatomaceae

India is supposed to be rich in diatoms, both living and fossil. However they have not been fully worked out from most of the places. In this connection noteworthy work has been done on the diatoms of Andaman and Nicobar, Sri Lanka, Maldiv Islands, Cochin, Colebrooke Islands and Trivandrum on the Western Coast of India. Some fresh water diatoms have been reported from Karewa beds of Kashmir. Desikachary and Maheshwari (1958) have reported them from Colebrooke Islands. It seems that there are more fossil diatoms than living ones in India. 230 species belonging to 57 genera are known in fossils in India; whereas only 27 species belonging to 14 genera of marine diatoms are known. Fresh water diatoms are known mostly from Kashmir, Bengal and Assam. Of the fresh water diatoms 80 to 85 per cent belong to Pinnales, whereas Centrales are rather poorly represented. The principal genera among the fresh water diatoms are Melosira, Fragilaria, Caloneis, Stauroneis, Pinnularia, Cymbella, Epithemia Navicula, Synedra, Amphipleura, Cymatopleura, Gomphonema, Nitz sha, Pleurosigma, Rhoiccsphenia, Rhopalodia, Surirella, Cyclotelia and Aimphora.

Majority of the fresh water diatoms are from the deposits where fresh water conditions once prevailed, but some had been also growing in brackish and marine waters. Cocconeis, Epithermia, Nitzschia, Navicula Cymbella grow in fresh as well as brackish water; on the other hand Coscinodiscus and Cyclotella grow in brackish as well as marine water. None of the Mesozoic diatoms had a raphe or speudoraphe; therefore, it is presumed that the ancestors of the diatoms might have been discoid, or cylindrical organisms (Wordnardt, 1972).

Marine diatoms are abundant on the coast of Colebrooke, Andaman and Nicobar Islands. They have extensive deposits of marine fossil diatoms, especially throughout Nicobar Islands in the Miocene strata. Fresh water fossil diatoms are known from Inter-glacial deposits of the Lower Karewas of Kashmir. In the Neogene flora diatoms belonging to the Centrales are abundant. In the Pleistoncene of India more of Pinnales with raphe, as in the genus Navicula, Nitzschia, Cymbella, are found. Most of the modern members of the Diatomaceae start appearing from the Middle of the Lower Miocene period. Many of them have continued through Pleiocene to Pleistocene to modern times; some have still living members.

Principal fossil genera among Pinnate diatoms are Amphiphleura, Caloneis, Denticula, Navicula, Plagigramma, Rhephoneis, Stauroneis.

Among Centrales genera Actinocyclus, Camphyloneis, Melosira, Stephanodiscus, Triceratium are common. However, certain genera have become extinct in Pliocene or Pleistocene. These are Auliscus, Camphylonsis, Endictya, Eupodiscus, Gephyria, Glyphodesmis, Rossiella, Triceratium, Rhaphoneis, Rhoicosphenies and Disploneis. It should be remembered that much of the oil from Cambay Basin and other places in Gujarat and elsewhere in India, belong to the Miocene period, and hence the occurrence of certain genera of diatoms in large proportion is of considerable significance in oil prospecting. About twelve genera of fossil diatoms have been found in the tufaecous deposits on the banks of Mula river at Kotur in Ahmednagar district.

ALGAE .69

3. Рилеорнута

The next group of the algae is generally recognised as the Phaeophyta or Brown Algae. The photosynthetic pigment in them the chlorophyll is masked by the golden brown pigment called Fucoxanthin. They are all marine plants. The classification is as follows:—

Class 1. Isogeneratae

Class 2.

Order 1 **Ectocarpales** 2 Sphaecelariales Tilopteridales Cutleriales Dictyotales Heterogeneratae Sub Class 1 Haplostichineae Order 1 Chordariales | Sporochnales Desmarestiales 2 Polystichineae Sub-class 1 Order Punctariales

2 Dictyosiphonales3 Laminariales

Class 3. Cyclosporeae
Order __ 1 Fucales

They are all large multicellular plants having zygospores. Gametes have two unequal cilia. About 190 genera and 900 species constitute this sub-class. Some of them grow in hot waters of Mediterranean Sea others in Tropical seas and still others grow attached to sub-strata by holdfasts in cold waters. Some are epiphytes and a few are endophytes They show marked distribution of forms in warm and cold waters. Sargassum, Dictyota, Laminaria are typical hot water plants, whereas Fucus grows mostly in cold waters right upto Arctic seas. Most of them grow in the littoral zone, and often get exposed to air after high tide, being left over by the receding waters of the sea tide. Simple sugars, pentoses are manufactured by them and stored. They also store poly-saccharides. Forms like Laminaria grow to a length of 20 to 25 meters and about 3 metres tall. The gametophyte and sporophyte generations at times look exactly alike. Many of them grow by a single apical cell-quite regularly.

The thalli of Fucus and Lanmiaria are differentiated into two distinct tissues, the central medulia of elongated colourless cells and cortex of isodiametric cells surrounding them. They have sexual mode of reproduction. The gametic fusion takes place either by isogamous motile gametes or by aniso-gametes in the cavities of the conceptacles. They are either male, female or hermaphrodite. They are divided into two main Orders:

- (1) Ectocarpales—Thallus with branched filamentous and multicellular sporangia.
- (2) Sphacaelarialles—The gametophyte produces many celled gametangia and unilocular sporangia. Fusion of gametesresults in producing two diploid generations in a life cycle, byt the sporophyte may be produced by neutral spores also.

The third Order of Pheophyta is Tilopteridales. It has trichothallic growth and free branches. The fourth Order Cutleriales has disc like thallus. The sporophyte produces unilocular sporangia. The fifth Order Dictyotales is characterized by erect, flat, pseudo-parenchymatous thallus which grows by means of a single apical cell. The sexual reproduction is by the liberation of egg. Fertilization is outside the body in water in the cavity of female or hermaphrodite conceptacle. The antheridia are many and liberate spermatozoides also in water.

Members of the other Orders Chordariales, Sporochnales, Desmarestiales, Punctariales, Dictyosiphonales, Fucales do not occur in Indian Sea Waters. The next large Orders are Laminariales, Dictyosiphonales, Chordariales. Of these, the Laminariales are the source of iodine. They are marine.

The Brown algae are often drifted to long distances and are collected for the various chemical substances such as iodine, gellatin, algenic acid, algates etc. which are of economic use. Theoretically they are the members of the littoral zone. They colonised land first and formed colonies, as such they are the pioneers in making land as their Habitat. Church (1898) has based his theory of Transmigration of water plants to land. Bower (1908, 1924) has traced the Origin of Land Flora to such coastal dwellers which were left on the moist coastal land surface during low tide and flooded back to water by sweeping high tide twice every day. They are supposed to have developed adaptations to subaerial life on land, dry or semi-aerial on land. This led to Land Habit.

The drift brought on the shore by the high tide, when available in bulk, forms the source of economic materials from sea algae. It is, however, not available in large bulk on the sea coast of Maharashtra as at Okha in Saurashtra or Tuticorin in Tamil Nadu.

3. Phaeophyta occurring in Maharashtra

Phaeophyta are not a large group in Maharashtra like the Chlorophyta. They contain yellow pigment phycoxanthin and phycobillin. Although they are economically important, they do not occur everywhere. They are marine forms growing either in temperate or tropical waters. The following list of Brown Algae of Bombay coast has been compiled mainly with the help of Dixit (1964) and the check list of Marine Algae by Krishnamurthy and Joshi (1978). They are all marine. The list of common members of Phaeophyta that occur at Bombay and at a few other places is given below. Total members so far known is 20. They are all marine. Fucus is not found on Maharashtra coast.

TABLE No. II-2

Name	Habitat	Remark
(1)	(2)	(3)
1. Ectocarpus mitcheltae Harv.	• •	All these are
2. Sphacaleria furcigera Kutz.	••	marine plants gro-
3. Dictyopteris acrostichoides J. Ag.	. • •	wing in ponds by sea side and
4. Dictyota bartayrasiana Lamour.	• •	estuaries.

TABLE No. II-2-contd.

Name	Habitat	Remark
(1)	(2)	(3)
5. Dictyota dumoss Boerg		
6. Dictyota maxima Zan		
7. Dictyota atomaria Hauck,		
8. Dictyota pinnatifida Kuetz.		
9. Dilophus fasciola (Roth) Howe.		
10. Spathoglossum asperum J. Ag		
11, Steochospermum marginatum (Ag.) Kuetz.	7	
12. Padina tetrastromatica Hauck		
13. Myrtactula arabica (Kuetz Foldm.		
14. Nemacystus desipiens (Sur. Kuck.		
15. Colpomenia sinuosa (Roth. Derb. et. Sol.		
16. Sargassum tenerrimum J. Ag		
17. Sargassum ilicifolium (Turn. Ag.		
Var. venusta Grun.		
18. Sargassum glaucescens	Vengurla.	
19. Sargassum marginatum .	Bombay.	
Summary of Phaeophytae, in Maharashtra. Family Ectocarpaceae	Bombay.	
1. Genus: Ectocarpus .		1 sp.
Family Sphacelariaceae		
2. Genus Sphacalaria	. .	1 sp.
Family Dictyotacae		
3. Genus Dictyopteris		1 sp.
4. Genus Dictyota		5 sp.
5. Genus Ditophus		1 sp.
6. Genus Spathoglossum		2 sp.
7. Genus Stoechospermum		1 sp.
8. Genus Zonaria		1 sp.
9. Genus Padina	1	1 sp.

TABLE No. II-2-contd.

Name	-	Habitat	Remarks
(1)		(2)	(3)
Family Chardariaceae			
10. Genus Myriogloea	(••	1 sp.
Family Corynophlaeaceae	1		
11. Genus Myriactula		••	1 sp.
Family Spermatochnaceae			}
12. Genus Nemacystus		••	1 sp.
Family Punctariaceas			
13. Genus Rosenvingea		••	1 sp.
14. Genus Colpomenia		••	1 sp.
Family Sargassaceae	1	Made	
15. Genus Sargassum	6		2 sps.
	-	Total Genera 15 and Species 20	

4. RHODOPHYTA:

Rhodophyta are the red coloured algae. They have a red pigment, Phycocrythm in addition to chlorophyl, and phycocyanin, the blue pigment. The red pigment being more in quantity if masks the other pigments. Barring a few exceptions most of them are marine algae. They contain 400 genera and 2500 species. About a dozen occur as fresh water forms, which generally live in well aerated waters of rapid cascades, falls, and such other swiftly flowing streams. Marine species occur in all oceans upto Arctic and Antarctic. Their distribution is co-related with the surface temperature of sea water. They also show vertical distribution according to temperature of water layers in intertidal zone. They grow sometimes about 2 to 200 metres in height or depth. They grow rooted intimately to the rocks or other inanimate objects. Some grow even epiphytically, others parasitically. But as a rule they are autotrophic. They have a single stellate chromatophore which stores naked pyrenoides which do not have starch sheath as in the Chlorophyceae. The chromatophores may also be disci-form. The starch formed is in the form of small solubel grains and is called Floridean starch. It is soluble in water. Most of the genera have multicellular branched or simple thallus. They propagate vegetatively by fragmentation or by means of carpospores.

The reproductive organs are borne on separate branches. Archegonium-like female sex organ is called carpogonium. It has one-celled trichogyne. The male reproductive organ is called antheridium or spermatangium and contains a single non-flagellate male gamete, the spermatium. Fertilization is effected by spermatium entering the trichogyne. The zygote forms a carpogonial body which divides into sixteen carpospores. Each carpospore forms a new plant.

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Red Algae are divided into two sub-classes, Bangiales and Florideales. Their classification is as follows:—

VII. Rhodophyta

Class	• •			Rhodophyceae
Sub-class	I		• •	Bangiodeae
Order	• •	• •		Bangiales
Sub-class	2	••		Florideae
Order	••	• •		1 Nemalionales
				2 Gelidiales
				3 Cryptonemiales
				4 Gigartinales
				5 Rhodymeniales
				6 Ceramiales

In India about 90 genera and 123 species have been recorded. Of these, the species of *Gracilaria* and *Gelidium* form the main source of agaragar. The two fresh water members of Red Algae are also known. They are *Batrachospermum* and *Nemalion*. Of these *Batrachospermum* is common in rapid flowing water of hill streams in Assam, Darjeeling, Lonavla and in some streams in the Western Ghats at several places like Dharwar, Honavar, Goa, etc. *Nemalion* does not occur in India.

The coastal algae of Maharashtra were surveyed by the famous Swedish Algologist Boergassan, and later by S. C. Dixit and by the members of the Central Salt and Marine Chemicals Research Laboratory at Bhavnagar, Dr. Thiwy, Krishnamurthy and Joshi. Stray references to them are also found in the works of De Toni, S. C. Dixit and others. The list given here is a combined list of marine Red algae based on the works of Boergessen (1930), Dixit (1964) and Krishnamurthy and Joshi (1970). Red algae are a very ancient group and are supposed to be related to Rust Fungi. They date as far back as Ordovician. The fossil members of Red Algae belong to the most advanced groups among them. The common genera found at Bombay and other places on west coast of India are given in the list of Marine algae on pp. (80-86) in the list of Algae of Bombay.

5. CYANOPHYTA

Cynophyta or Blue green algae, also called Myxophyceae, occur as gelatinous masses of various shapes, floating in water or growing in bits on moist surfaces. They occur generally in groups and seldom as single cells. They do not possess organised nucleus or central vacuole. The gelatinous material secreted by their protoplast forms a sheath around them. They multiply by fragmentation or by eyst-formation. They live in fresh water and sometimes form 'Water Blooms'. They are found on damp soil, rocks, ledges, bark of trees with dripping water. They can grow below the surface of soil about a metre or form a thin coating on it. They are essentially colonial forms and can grow at any temperature 40-75°C in hot water springs.

They are branched or grouped in gelatinous sheath or they occur as chains of individual cells. They contain a pigment called Phycocyanian, and also a red pigment similar to Phycocyythrin. The pigments are

diffused in protoplasm. Since they have no nucleus, their genes are distributed in plasma. The vegetative reproduction is by means of fragmentation, isolation, or by the formation of heterocysts and hormogones. There is no sexual reproduction. No flagellata gametes or zoospores have been found in them. Akinetes or cyst-formation is common. They are a very ancient group and are capable of surviving under the most trying extreme conditions. They are susceptible to viral attacks. Some of them have the capacity to fix atmospheric Nitrogen, e. g. Blue Green algae growing in rice fields. They have been divided in three Orders depending upon the filamentous or non-filamentous nature of the thallus and mode of reproduction.

- 1. Chroococcales.—These are Colonial forms which multiply by vegetative cell division and fragmentation of colonies. There are 35 genera and 250 species all fresh water.
- 2. Chamaesiphonales.—These grow epiphytically, singly or gregariously or in colonies. They form endospores.
- 3. Hormogoniales.—They are filamentous forms with whip-like trichomes having united cells. They multiply by akinete formation or heterocysts or hormogones. About 90 genera and a thousand species are found. In India they have been surveyed by Desikachari (1969), Singh (1939), Gonsalves and Kamat (1954), Kamat (1961-62) etc. Their list in Maharashtra so far known is given in the following Table II-3.

TABLE No. II-3

Cyanophyta of Maharashtra

Name	Habitat	Remark
(1)	(2)	(3)
1. Family Chroococcaceae Nageli	सःयम्ब जयते	
Microcystis aeruginosa flavirid is Golankin.	Found occasionally in distant lakes	••
Microcystis aeruginosa Kuetz.	Common in many stagnant lakes, Igatpuri, Bombay.	
Microcystis flosaquae (Wittn) Krichnar.	Common in inland ponds.	
Microcystis stagnalis Lemm	In a tank at Bandra.	
Microcystis insignia (Beck) Desikachari.	In Bombay, on surface of a tank.	
2. Chroococcus turgidus (Kuetz) Nag.	A planktonic form often seen with mangroves submerged or on sub- aerial part of tree trunk.	
3. Chroococcus schiz oder maticus West.	In paddy fields at Dahisar, Bombay.	
Chroococcus hansigirgi Schmidle.	On moluscan shells in a lake, Pune.	
Chroococcus paidus Nag	Igatpuri, Borivli, Jogeshwari caves near Bombay, on stone walls at Mahabaleshwar.	·

TABLE No. II-3-contd.

Name	Habitat	Remark
(1)	(2)	(3)
4. Glosocapsa strata (Turp Kuetz.	A blackish mucilaginous crystace- ous alga.	
Gloeocapsa crepidinum . Thuret.	Crust forming Alga, Pune.	
Gloeocapsa violacea (Corda Rabenh.	Igatpuri,	
Gloeocapsa granosa (Berk Kuetz.	Found in hot water springs at Vajreshwari growing at a tempe- rature 34° C.	
5. Aphanocupsa littorat is Hansg	Sea shore near Chowpati, Bombay.	
A. macrococca Hansg.	Bembay.	
Aphanocapsa pulchra (Kuetz.) Rabenh.	In sait pans near Dadar.	
G. S. West.	In a tank at Bandra, Bombay.	
var, Conferta W. et. G. S West,		
Aphanocapsa thermalis (Kuetz) Brugg.	In hot water springs at Vajreshwari near Bombay.	
6. Aphanothece conferta Richter	Found in cultures of soil at Thane and Goregaon.	
Aphanothece castagnei (Breb.) Rabenh.	Forms scum on the surface of ponds or grows epiphytically, Borivli,	
Rabenh.	In paddy fields or floating free in ponds.	
<i>Aphanotheca pallida</i> var <i>minor</i> Dixit.	In the bed of stagnant rivulets near Santacruz and Kurla.	
7. Coelosphaerium Nag	In rain water ponds at Jogeshwari caves, Bombay.	
8. Merismopedia minima Beck	Forms small colonies on the surface of water.	
Merismopedia glauca (Ehrenb.) Nag.	In fast running streams, shallow pools, mangrove swamps, Bombay.	
Family Entophysalidaceae Geitler.		
9. Chamaesiphon fuscus (Rostaf.) Hansg.	Danger point, Bombay.	
Family Hyellaceae Borzi.		
10. Scopulonema concharum (Hansg.) Geitler.		
amily Oscillatoriaceae Krichner		
11. Spirulina subsalsa Oerstd	In hot water springs at Vajreshwari, Bombay, Near Colaba seashore, Bombay.	
Spirulina major Kuetz	Bandra, Bombay. In stagnant salt pan waters.	

TABLE No. II-3-contd.

	Name	Habitat	Remark
	(1)	(2)	(3)
12.	Oscillatoria sancta (Kuetz.) Gomont.	In rain water pools at Dharavi road and Mahim, Bombay.	
	Oscillatoria subbrevis Schmidle F. crassa Dixit.	Rain water pools at Borivli also on moist soil at Borivli.	
	Oscillatoria anquina (Bory) Gomont.	In paddy field soils at Goregaon Bombay.	
	Oscillatoria proboscidea Gomont.	Dahisar, In hot water springs at Vajreshwari at 38°C.	
	Oscillatoriu chalybea (Martens) Gomont.	Bombay.	
	Oscillatoria Jasorvensis Vouk	In hot springs at Vajreshwari.	
	Oscillatoria tenuis Ag. ex. Gomont.	Bombay.	
	Oscillatoria irriqua Kuetz	On moist soil, Bombay.	•
	Oscillatoria gloiophila Gomont.	Bandra tank, Bombay.	
	Oscillatoria schultzii Lemm	Paddy fields at Thane.	
	Oscillatoria formosa Bory	In tanks, salt lake filters, lakes at Bombay.	
	Oscillatoria animalis Ag. V. tenuior Stockmeyer.	In paddy fields at Dahisar, Goregaon, Bombay.	
	Oscillatoria acuminata Gomont.		
	Oscillatoria serpentina Richler.	In Western ghats, Pune.	
13.	Porphyrosinhon notarisii (Manegh.) Kuetz.	On moist soil or fresh water Bombay. In rice fields also.	
14.	Phormidium africanum Lemm.	In hot springs at Vajreshwari near Bombay at 40 to 50°C. The Bombay-Algae differs much from the type having broader diameter.	
	Phormidium foveolarum Gomont.	On moist soil in rice and wheat fields in Goregaon, Dahisar,	
	Phormidium jenkelianum Schmid.	Khandala, Lonavia. In paddy fields moist walls of drains, Thane.	
	Phormidium valderienum (Delp) Gomont,	Water logged soi at the bottom of pools. Paddy fields at Dadar, also Mahabaleshwar.	
	Phormodium ratzii (Ag.) Gomont,	On rocks near streams or on sub- merged objects, Parel near Bombay.	
	Phormidium inundatum Kuetzing. west	On walls with fresh water dripping on them.	
	Phormidium sp. Schmidle	On tree trunks at Pune and Bombay.	

TABLE No. II-3-contd.

Name	Habitat	Remarl
(1)	(2)	(3)
15. Lyngbya inflexa Fremy	Bandra.	
Lyngbya cryptovaginata Schkorbatow.	In rain water pools inside the caves at Jogeshwari.	
Lyngbya aestuarii Liehm	In planktonic lakes growing epi- phytic on sponges. Dadar, Parel, Mahalaxmi, Matunga.	
F. spectabilis Gom	Occurs in hot water springs at Vajreshwari at 34-36°C.	
Lyngbya erabi W. et. G. S. West.	On mud and stone walls submerged in flowing water at Borivli.	
Lyngbya allorgei Fremy	On mud and stone walls submerged in floating water at Borivli.	
Lingbya putealis Mont ex. Gomont.	In hot water springs at Vajreshwari at 40-45°C temperature.	
16. Schizothrix aranaria (Berk) Gomont,	Paddy fields at Thane, Goregaon, Dahisar.	
Schizothrix tenuis Woronichin.	In paddy fields soil culture, Khan- dala.	
Schizothrix lamyi Gomont	At Panchgani,	
17. Sirocoleus kurzii (Zeller) Gomont,	This genus occurs on large marie Algae and submerged roots of Rhizophora at Bandra seaface and Malbar Hill.	
18. Microcoleus ehthonoplastes Thur.	Bandra seaface, Dadar, Bombay.	
19. Hydrocoleum meneghinianum Kuetz	Bombay.	
Hydrocoleum heterotrichum Kuetz.	Parel, Matunga in Bombay.	
Family Nostocaceae Kuetzing Sub- family Anabaenae.		
20. Anabaenopsis sp	Common.	
21. Cylindrospermum licheni- forme (Boty) Kuetz, var, langispora Di _x it.	Mahalaxmi point,	
22. Nostoc punctiforme (Kuetz.) Hariot.	Bombay,	
Nostoc linckia (Raoth) Boret ex. Born at Flah.	.,	
Nostoc humifusum Carmi- chael.	Paddy fields soil at Khandala and Lonavla.	

TABLE No. 11-3-contd.

Name	Habitat	Remark
(1)	(2)	(3)
Nostac calcicola Bre'b .	On moist soil at Panchgani and paddy field soil at Dahisar, Goregaon and Thane.	
Nostoc muscorum Ag	. Paddy fields near Thane.	
Nostoc commune Vaucher .	. In stagnant water, moist rocks on soils at Neral.	
Nostoc microscopicum Carr	n Epiphytic and on moist surface at Matheran.	
Nostoc hatei Dixit	On water plants in stagnant pools at Santacruz, Bombay.	
23. Anabaena sphaerica Bone at Flah.	t In fresh water ponds near Dadar.	
Anabaena fertilissima Rac C. B.	Bandra Tank, Bombay.	
Anabaena gelatinicola Ghose	In ponds and tanks at Borivli and Bandra.	
Anabaena beckii De Toni	In marshes near Bombay.	
Anabaena orientalis Dixit	Rain water pools at Mahalaxmi near sea coast and in hot water springs at Vajreshwari.	
Anabaena cacillarioides Bory	Rain water Borivli, Bombay.	
Anabaena hansgirgi Schmidle	On trees at Matheran.	
Anabaena voltzii Lemm.	सन्यमेव जयते	
Anabaena bombayensis ,. Gonzalves.	On the tank walls connecting hot springs at Vajreshwari.	
Anabaena laxa (Rabenh) A. Br.	In a lake at Pune.	
Anabaena inplexa Born. et. ex Flah.	In the bed of river at Borivli.	
Family Scytonemataceae		
24. Plectonema hansgirgi Schmidle.	On tree trunks at Matheran, in paddy fields at Thane.	
Plectonema gracillimum (Zopf) Hansgirg.	In hot water springs at Vajreshwari and paddy fields at Thane.	
25. Scytonema javanicum (Kuetz) Bornet.	On moist soils, Bombay.	
Scytonema hansgirgi Schmidle.	On the barks of trees around Pune.	
Scytonema hofmanni Ag	Mahim, Igatpuri, Mahabaleshwar, Bombay, on stones, soils and trees.	
Scytonema tolypothrichoides Kuetzing.	Hot springs at Vajreshwari.	

TABLE No. II-3-contd.

Name	Habitat	Remark
(1)	(2)	(3)
26. Tolypothrix tenuis (Kuetz.) Schmidle.	In moist soil and walls at Gavdevi.	
Tolypothrix distorta Kuetz	Bandra tank.	
Var. penicillata (Ag.) Lemm.	In stagnant ponds and rivulets at Borivli.	
Tolypothrix bouteillei (Bre'et Desm.) Forti.	Paddy fields near Goregaon.	
27. Microchaete calothricoides Hansgirg.	In paddy fields near Goregaon, Bombay.	
28. Calothrix fusca (Kuerz.) et. Flahault.	On dead tree trunks especially in pools of Matheran.	
Calothrix epiphytica W. et. G. S. West.	Bombay, on shells at Thane.	
Calothrix marchica Lemm	In paddy fields, Bombay.	
 Dichothrix gypsophila (Kuetz.) Born. et, Flah. 	Igatpuri, rain water ponds at Bombay.	
Dichothrix baueriana (Kuetz.) Born, et, Flah.	Igatpuri and Matheran on tree trunks.	
Dichothrix orisiniana (Kuetz) Born. et. Flah.	Igatpuri and Matheran.	
30. Rivularia hansgirgi Schmidle	Between mosses growing on earth at Igatpuri.	
31. Gloeotrichia indica Schmidle	In lake at Igatpuri.	
Goeotrichia raciborskii Woloszynska.	Borivli, Bandra.	
Var. bombayense Dixit	Free floating in stagnant rivulets at Goregaon.	
Var. conica Dixit	Free floating or attached to <i>Chara zeylanica</i> at Santacruz.	
amily Nostochopsidaceae Gaitler.		
32. Nostochopsis hansgirgi Schmidle.	On rocks in rivulets at Goregaon.	
33. Hapalosiphon baronii W. et. G. S. West.	In lakes at Igatpuri.	
34. Camptylonema indiction Schmidle.:	On thee trunks at Mahim.	
35. Stigonema ocellatum (Dillw.) Thuret.	In paddy fields at Pune.	

Note.—This list is prepared with the help of Works of Dixit, Desikachari, Mrs. R. Gonzalves, Mrs. Marathe, Kamat and others.

BOTANY AND FLORA

TABLE No. II-4

6. MARINE ALGAE OF MAHARASHTRA AND WEST COAST OF INDIA

Name		Habit a t	Remark
(1)		(2)	(3)
CHLOROPHYTA CHLOROPHYCEAE ULVALES	•		
Family Ulvaceae			
Enteromorpha flaxuosa (Wulf). J. Ag.		Bombay, Dwarka. (Boergesen 1934, 35). Malwan harbour (Dixit, 1948).	
Enteromomorpha prolifera (Fl. Dan.) J. Ag.	• •	Bombay (Boergesen, 1935).	
E. tubulosa Kuetz	••	Bombay,	
Ulva lactuca (L.) Le Jolis.		Bombay.	
U. reticulata Forssk	P	Bombay.	
CLADOPHORALES	(2) (6) (6)		
Family Cladophoraceae	9		
Chaetomprpha area (Dillw.) Kuetz.	8	Bombay.	
C. clavata (Ag.) Kuetz		Bombay.	
C. darwinii (Hooker) Kuetz	Charles and the	Malvan harbour (Dixit 1949) was earlier described as C. media. Later Dixit placed this species under C. darwini and further stated that C. clavata recorded by Boergesen (1935) from Bombay is the same as this.	
C. indica Kuetz	٠.	Bombay (Boergesen, 1955),	
C. colubense Boergesen		Bombay.	
C crispata Kuetz Var, acuta P. Richt.	••	Deccan.	
Cladophora fascicularis (Martens) Kuetz.	• •	Bombay.	
C. saracenica Boergs	• •	Bombay.	
Lola capillaris (Kuetz) A. et. G. Hamel.	• •	Bombay.	
Rhizoclonium grande Boergs	٠.	Bombay.	
R. kochinum Kuetz	إ	Bombay.	
SIPHONALES	ļ		
Family Protosiphonaceae			
Bryopsis hypnoides Lamour .		Okha Port.	
B. indica A. and E. S. Gepp	,	Indian Ocean.	

TABLE No. II-4-contd.

	SLE NO. 11-4conta.	l
Name	Habitat	Remark
(1)	(2)	(3)
CAULERPACEAE		
Caulerpa fastigiata Mont	Bombay.	
C. peltata Lamour	Bombay.	
C. racemosa (Forssk.) Weber V. Bosse.	Bombay.	
C. scalpelliformis (R. Hr.) Web. v. Bosse.		
F. dwarkensis Boergs	Bombay.	
Var. intermedia Web. v. Bosse.	Bombay.	
C. crassifolia (Ag.) J. Ag.	Bombay,	
Trichosolen mucronatum (Boergs.) Taylor.	Bombay.	
Family Dasycladaceae		
Acetabularia moebii Solms- Loubach.	Indian ocean Malvan.	
Family Codiaceae	141111	
Codium indicum Dixit	Malvan harbour.	
C. latum Sur	Bombay.	
Halimeda papyracea Zan	Indian ocean.	
Family Valoniaceae		
Boodlea composita (Harv. et Hook. f.) Brand.	Dwarka, Okha.	
Chamaedores auriculata Boergesen.	Bombay, Dwarka, Indian Ocean.	
Cladophoropsis sundannensis Reinb.	Bombay, Dwarka.	
Struvea anastamosens (Harv) Piccone.	West coast of India.	
S. delicatula Kuetz	Bombay.	
Family Bryopsidaceae		
Pseudobryopsis mucronata (Boergs.)		
BACILLARIOPHYTA		
See under Bacillariophyta (p. 68).		

TAB	LE No. II-4—contd.	
Name	Habitat	Remark
(1)	(2)	(3)
РН АЕОРНУТА		
DICTYOTALES		
Family Dictyotaceae		
Dietyota dumsoa Boergeson	Bombay.	}
D. indica Sonder	Bombay.	
D. maxima Zanardini	Bombay.	
D. pinnatifida Kuetz	Bombay.	
Dilophus fasciola (Roth) Howe.	Bombay.	}
Padina tetrastromatica Hauck	Bombay.	
Pocockiella variegata (Lamour) Popenfuss.	Dwarka.	
Spateglossum asperum J. Ag.	Bombay.	
S. variabile Fig. et	Okha port.	<u> </u>
Stoechospermum marginatum (Ag) Kuetz.	Bombay.	
Zonaria variegata (Lamour) Ag.	Malvan, Dwarka.	
CHORDARIALES		
Family Myrionamataceas		
Ascocyclus orbicularis (J. Ag.) Magnus.	Dwarka.	
Hecatonama terminalis (Kuetz) Kylin.	Bombay, Dwarka.	
Myrionema strangulans Greville.	Porbandar.	
RI	HODOPHYTA	
BANGIOPHYCEAE		i
FIORIDEOPHYCEAE		
NAMALIONALES		<u>{</u>
Family Chantransiaceae		
Acrochastium sarqassicolum Boergs.	Bombay.	
ERYTHROPELTIDALES		
Family Erythropeltidaceae		
Erythrotrichia carnea (Dillw.) J. Ag.	Bombay.	

TABLE No. II-4-contd.

Name	Habitat	Remark
(1)	(2)	(3)
Erythrotrichia carnea J. Ag.		All marine
Acrochastium sarqassicolum Boergs.		
Gelidium pusillum (Stackh) Le Jolis.		
G. pulvinatum (Kuetz.) Thur. —forma parvissima.		
G. heteroplastos Soergs.		
G. corneum (Hude.) Lamour.		1
G. variabilis (Grew.) Schmitz.		1
Gelidiella myriocladio (Boergs.) Feldm. st. Hamel.		
Caulacanthus ustulatus (Mart.) Kuetz.		
Peyssonelia obscura Weg. var. bombayansis Boergs.		Do.
Cruoriella bicolor Boergs.		
Hildenbrandia prototypus Nardo. Amphiroa fragilissima (L.)	TATION	
Lamour. Chailosporum spectabiliie		
Harv. Jania rubens (L.) Lamour.	nomia and	}
Solieria robusta (Grev.) Kylin. var Waghlii.	ললশন সধ্য	
Grateloupia filicina (Wulf.)		
Sarconema filici forma (Sond.) Kylin.		
Catenella repens (Lightf). Batt.		
Hypnea valentiae (Turn.) Mont.		
H. musciformis (Wulf.) Lamour.		
Gracilaria folifera (Forssk.) Boergs.		
G. corticata var ramalinoides J. Ag.	••	Do.
Gigartina acicularis (Wulf.) Lamour.		
Rhodymenia australia Sond.		
Monospora indica Boergs.		
Centracaras clavulatum (Ag.) Mont.		Do.
Spyridis alternans Boergs.		

TABLE No. II-4-contd.

Name	Habitat	Remark
(1)	(2)	(3)
Myrlogramme bombayensis Boergs.		
Caloglossa leprieurii (Mont.) J. Ag.		
C. bombayensis Boergs,		
Laurencia papillosa (Forssk) Grev.		
Chondria dasyphylla (Woodw.) Ag.		
C. cornuta Boergs.		
Acanthophora delilei Lam.		
Polysiphonia platycarpa Boergs.		All marine.
P. variegata (C. Ag.) Zan.		
Falkenbergia rufanu losa (Harv.) Schimitz.		
Batrachospermum monliforme Roth.	Vitrali "	Only fres water for
GELIDIALES	THIE	in Maharashtr
Family Gelidiaceae		
	Bombay.	
G. pulvinatum (Kuetz) Thurst	Bombay.	
G. pusitjum (Stackh.) Lejolis.		
Family Gelidiellaceae		1
Gelidiella bornetii (Web. v. Bosse). Feldmann et. Hamel.	Bombay.	
G. myrioclada (Boergs) Feldmann et. Hamel.	Bombay.	
CRYPTONEMLALES		
Family Squamariaceae		
Peyssonelia obscura Web. V. Bosse var. bombayensis Boergs.	Bombay.	
P. bicolor Boergs	Bombay.	{
Family Hilderbrandtiaceae		
Hildenbrandtia prototypus Nardo.	Bombay.	

TABLE No. II-4-contd.

TABL	E No. II-4—contd.	
Name	Habitat	Remark
(1)	(2)	(3)
Family Corallinaceae		
Jania rubeus (L.) Lamour.		
Family Grateloupiaceae		
Grateloupia filicipa (Wulf.)	Bombay.	
Family Gracilariaceae	Domhay	
Gracilaria corticata J. Ag		
G. foliifera (Forssk.) Boergs.	Bombay.	
Family Sphaerococeaceae	_ ,	
Caulacanthus ustulatus (Mert) Kuetz.	Bombay.	
Family Solieriaceae		
Sarconema filiforme (Sond.) Kylin.	Bombay.	
Family Rhabdoniaccae		
Catenella repens (Lightf.) Batt.	Bombay.	
Family Hypneaceae	447677	
Hypnea valentiae (Turn.) Mont.	Bombay,	
Family Gigartinaceae	सत्यमेव जयते	1
Gigartina acicularis (Wulfen) Lamour.	Bombay.	
RHODYMENIALES		
Family Rhodymeniaceae		
Rhogymenia australis Sonder	Bombay.	
CERAMIALE		ļ
Family Ceramiaceae		
Centroceras clavulatum (Ag.) Mont.	Bombay, Dwarka.	
Corynospora indica Boerges	Bombay.	
Spyridia filamentosa (Wulf.) Harvey.	Bombay.	
Family Delessriaceae		- 1
Acrosorium bombayensis Boergs.	Bombay.	
Acrosorium leprieurii (Mont.) J. Ag.	Bombay.	

TABLE No. 11-4-contd.

Name	Habitat	Remark
(1)	(2)	(3)
Family Rhodomelaceac		
Acanthophora delilai Lamour	Bombay, Okha Port.	
Chondria cornuta Boergs	Bombay.	
Taurencia palillosa (Forsek.) Greville.	B ombay.	
Polysiphonia platycarpa Boergs.	Bombay	
Polysiphonia variegata (Ag.) Zanardini.	Bombay, Okha port.	

Summary:

All Myxophyceae and the great majority of the Chlorophyceae, Bacillariaceae are fresh water algae. On the other hand, all Pheophyceae except *Ectocarpus* and the Rhodophyceae with the exception of *Batrachospermum* are marine algae. The list of Pheophyceae and Rhodopyceae are given separately in their proper places. Myxophyceae are fresh water forms. They are also given separately. Taken together tentatively they are as follows:—

(1) Myxophyceae.—Have no marine members. All are only fresh water.

Genera 95 Species 220

(2) Chlorophyceae. —These are both fresh water as well as marine forms.

A—Fresh water forms

Genera		 150
Species	• •	 331
B-Marine forms		
Genera		 51
Q		0.3

- (3) Pheophyceae.—All members are marine. The known genera are 15 and species about 20.
- (4) Rhodophyceae.—Execpting the genus Batrachospermum which looks like a green alga and grows in fresh water, all others are marine. The number of marine Red algae is—

Genera 94 Species 120

4. Fossil algae.—The account of the fossil algae of Maharashtra occurring in different strata would be given elsewhere.

In all 385 Genera and 828 species of algae, excluding fossil algae, are so far known from Maharashtra. These numbers are bound to change as fresh work on algae at different places would come out. They would therefore, be considered only as tentative and not exhaustive.

The following Algae are common to Bombay and Ratnagiri-Sindhudurg coasts:—

CHLOROPHYTA:

- 1. Enteromorpha flexuosa (Wulf.) J. Ag.
- 2. Chaetomorpha darwinii (Hook.) Kuetz.
- 3. Trichosolen mucronatum (Boergs.) Taylor
- 4. Chamaedoris auriculata Boergs.

Рнаеорнута:

- 1. Dictyota maxima Zanardini
- 2. D. pinnatifida Kuetz.
- 3. Stoechospermum marginatum (Ag.) Kuetz,
- 4. Nematocystus decipiens (Sond.) Kuck.

RHODOPHYTA:

- 1. Gelidiella acerosa (Forssk) Feldmann et. Hamel.
- 2. Coelarthrum muclleri (Sons.) Boergs.
- 3. Spyridia alternans Boergs.
- 4. Caloglossa leprieurii (Mont.) J. Ag.
- 5. Nitophyllum punctatum (Staekh.) Greville.
- 6. Laurentia pedicularicides Boergs.

The following algae are found at Ratnagiri-Sindhudurg coastal areas but not at Bombay:—

CHLOROPHYTA:

Codium indicum Dixit

Acetabularia

Рнаеорнута

Zonaria variegata (Lamour.), Ag.

Sargassum cinereum J. Ag. var. barberifolia Gruenow

S. glaucescens J. Ag.

7. HABITATS OF ALGAE

Algae are highly susceptible to habitat changes, and the factors under which they grow. Different algal communities are formed depending upon the availability of food, range of temperature, oxygen content of water, pH, duration of light etc., particularly of Chlorophyceae, and diatoms. Like higher plants they are also affected by fungi and viruses. Mucilage secreted by the Cyanophyceae in fresh water attracts many organisms. They are Laurania verigata, Helminthoaladia australis. On rocks exposed to heavy brakers, species of Chaetomorpha, Cladophora, Porphyra tenara, Gracillaria corticata are found. In rocky puddles of different depth in the tidal zones species of Enteromorpha, Chaetomorpha

prostrata, Acetabularia species, Caulerpa racemosa, Bryopsis pinnata, species of Padina and Gracilaria occur. In very rocky pools Caularpalongifolia, Acitabularia sp., Codium dwarkensae are found. In salt marshes Enteromorpha compressa, E. prolifera, Rhizoclonium cochinianum and Cladophorella zoolingeri are found. In oyster beds Halymenia flexia, Gracilaria and Hypneum species are found. On the walls of fresh water reservoirs Cladophora and Enteromorpha are common.

The distribution of algal species depends upon the factors of the habitat such as—

(a) Nature of substratum, (b) Pressure, (c) Temperature, (d) Duration of light, (e) Salinity and pH, (f) Shelter available, (g) Silt in tidal zone, (h) Exposure, etc.

Habitatwise classification of Algae is given by Tiffani (1951) in *Manual of Phycology*, pp. 293-311 as follows:—

- 1. Hydrophytes .. Algae more or less completely submerged or floating.
- 2. Benthophytes .. Algae growing on mud at the bottom of water and subtratum.
- 3. Epactiphytes ... Algae growing along banks of lakes and ponds.
- 4. Thermophytes .. Algae of thermal springs and in hot water as at Vajreshwari.
- 5. Planktophytes ... Algae that floats on water.
- 6. (a) Euplanktophytes True floating algae.
 - (b) Tychlophytes .. Flaoting mats of algae, due to accident of wind or other agencies.
 - (c) Halophytes ... Algae of waters with high salt concentration.
- 7. Epiphytes Algae growing on other plants.
- 8. Epizoophytes .. Algae growing on animals.
- 11. Endophytes .. Algae growing within other plants.
- ill. Saprophytes .. Humus rich surface algae.
- IV. Cryptophytes .. Subterranean algae.
- V. Acrophytes Algae floating on sheets of snow.
- 8. HABITS OF ALGAE

Algae are extremely choosy in their habitat. Many of them grow in marine waters, some on coast, some in estuaries, some on moist soil and rock surfaces, wet walls, some in fresh water lakes, in flowing river streams,

places where water is dripping, in isolated ponds and puddles, permanent sheets of water or temporary monsoon ponds etc. Some grow in soil. A few grow epiphytically on tree bark. A very few grow on leaves. Some grow symbiotically. They generally indicate fresh or stagnant condition of water, depending upon the species growing therein. Some grow on pebbles in flowing river or at the bottom of ponds. Some float on surface of large sheets of water in lakes and sea,

Feldmann (1937) has classified the Biological or Life Forms of algae as follows:—

I. Annuals:

- (a) Ephemerophyta.—Forms that are found all the year round forming several generations without any resting period e.g. Cladophora, Enteromorpha, Polysiphonia.
- (b) Edipsiophyta.—Plants that are reduced to microscopic forms during their life cycle in one part of the year or the other, and become megascopic again during the other part e.g. Nereia, Sporochnus.
- (c) Hypnophyta.—Algae that form resting stages or cysts during the year e. g. Ulothrix, Oedogonium Spirogyra, Chara, Vaucheria, Porphyra.

II. Perennials:

- (a) Phanerophyta.—These have perennial growth habit e.g. Codium Chara, Fucus etc.
- (b) Chamaephyta.—Here the whole plant body is perennial growing horizontally as encrustment e.g. Lithophyllum, Hilderbrandtia.
- (c) Hemicryptophyta.—Plants in which only the basal part persists throughout the year and forms new plants by means of creeping filaments e. g. Acetabularia, Cladostephus.

Many algae form distinct plant communities growing on the bottom mud of a body of water. Some grow in hot water springs at a temperature 40°-87°-C e.g. Oscillatoria, Trevis, Nostoc and Haplosiphon species., some grow even below snow.

In tropical seas algae form huge masses of plankton in which several Flagellates, Cyanophyceae, Desmids, members of Chlorococcales grow together with many animals. Some grow in salt marshes and have marine species. These are really the halophytes e.g. Prasiola, Enteromorpha, Cladophora, Pithophora, Ulva, Padina etc.

Epizoophytes:

Some algae grow on other organisms, such as snails, mosquito larvae, turtle, fish, sponges etc. e.g. Characium, Chlorella etc. Epiphyllous algae growing on tree bark e.g. Nostoc, members of Chroococales etc., Cephaleura grows on Tea leaves.

Soil Algae:

The soil algae generally grow at the surface of soil or in the soil upto about a metre depth below the soil level. Surface dwellers are Oscillatoria, Lingbya, Phormidium, Navicula, Nostoc etc. Those that grow deep in the soil are Cephaleura, Polysiphonia, Plerococcus species.

Algae on calcarious soil.:

They are calcicoles and prefer to grow on calcarious soil e.g. Phormidium, Prasiola, Trentepohlia, Stigonema.

Symbiotic Algae:

It is well known that *Nostoc* grows within the roots of *Cycads* and *Anabacna* in the leaf folds of *Azolla* symbiotically. *Fritschiella*, *Botrydium* and *Chlorella* grow on the edge of ponds where a lot of animal excreta are dropped. They are supposed to be good oxidants. Some algae like *Volvox* grow isolated in walls or in temporary mountain pools. Here they perennate by the formation of cysts.

Rocky pools of fresh water:

These contain Ulothrix, Cladophora, Tolypothrix, Spirogyra Coleochaete, Oedogonium, Zygnema species.

Algae in rain water pools:

Rain water pools which dry up later often contain Euglena, Rhizo-clonium, Microspora, Ulothrix. They are dominant in summer.

Algae of Brackish water:

Cladophora, Pithophora, Bryopsis etc. have species which are halophytes. Calothrix, Euglena, Vaucheria grow on moist soil rich in humus and supplied with brackish water.

Microspora, Ulothrix. Bulbochaeta are found as epiphytes on aquatic plants. Chlorella occurs in the cells of Hydra. It fills tank completely.

Marine Algae:

In tropical deep waters mass of plankton forms a spectacular sight. In shallow waters towards the coast diatoms occur in profusion. In temperate countries algae generally show zonation, e. g. belts of one plant community growing by the strip of another plant community, especially if the shore is rocky, along alkaline cliffs e. g. at Dover, Cardiff in England. Such a phenomenon, however, is not very marked in India except on the Saurashtra coast at Veraval, Okha, and at Khodiar, Cape Camorin etc.

It will be seen from the above how rich we are in both fresh water and marine algae. Their utilization is dealt with in next section 10 although, it has to be admitted that not much has been done for industrial purposes. In these days of industrialization, green algae will become more and more important as fertilizers and as agents in oxygenation ponds.

9. ECOLOGICAL SUCCESSION PERIODICITY AND DISTRIBUTION OF ALGAE IN FRESH WATER LAKES IN MAHARASHTRA. RANKALA LAKE (KOLHAPUR) AS AN ILLUSTRATION.

Studies on algae of the old Bombay Presidency really began with the work of A. J. Cerlers (1858) who made a study of some members of Volvocaceae, Flagellates in puddles in Bombay. In 1863 Hobson described two new species of *Dosodium pistidas* Hobs collected at Mahabaleshwar. A few members of the other fresh algae belonging to Myxophyceae, Chlorophyceae, Distemaceae and Desmidaceae were also mentioned by workers like Nellie Carter in her paper on fresh water algae from India.

After initial period, a number of botanists of different countries took interest in studies on algae in India. Eventually the Rev. Father Ethelbert Blatter S. g. of St. Xavier College, Bombay made several collections of algae. Later S. C. Dixit and Mrs. E. Gonzalves and her students N. D. Kamat, Mrs. Ganla, Vaidya made several contributions to the studies on algae. A large number of algae of different groups at Dharwar, Bombay, Ahmedabad, Nagpur, Aurangabad were studied and described by Dixit, Gonsalves, Ganla, H. P. Gandhi, N. D. Kamat, R. G. Patil, M. S. Balakrishnan and others.

Most of these studies dealt with taxonomy of algae and a few with cytology and life cycles. Balkrishnan was the only one to study cytology, ecology and distribution at a few places in Maharashtra where a number of ecological nitches encourage rich aquatic vegetation including algae. The basic rock in most places was trap or basalt. It provided water and debris subsequently gathered in pools and gave rise to particular algal flora. The only detailed account of such plant communities is by Kamat (1965) who studied fresh water lakes and puddles around Kolhapur 16° 42' and 7.8° 14' E, altitude 570' above the mean sea level. pH of water in many places is slightly alkaline varying from 7-6 to 8-5.

Periodicity of algae in Temporary Ponds and Lakes:

Many of the ponds in Kolhapur are rain water ponds or puddles, but some lakes have permanent water. Rain water puddles generally dry up after October, and with the onset of first rains Volvox, Clamydomonas, Gloecystis, Tetraspora, Ulothrix begin to appear. Cylindrocapsa geminella appears in September, Protococcus viridus, Stigeoclonium lubricum become quite common by June. Cladophora perciformis and C. elegans generally inhabit permanent waters till May. Coleochaete scutata, C. irreqularis and C. orbicularis appear in September-October and last till January. By far the common members of Chlorophyceae that appear in temporary and permanent ponds are species of Oedogonum purrituen, O. regulosum. They come to fruiting in January and remain till the end of May. O. longipilum, O. lanturense and O. pusillum produce generation after generation till May, while O. E. pseudispirale, Oetapeius sporum produce the first generation in September, and second in January. One species of Bulbochaete brerfulla appears in August and produces fruitifications till January. Oedocladium species appear on moist soil in July and last till the end of rainy season.

Enteromorpha proflifera grows from January to May. As the temperature of water rises Pithophora oedogerua is found from July to May. Cladophora callicoma grows attached to rocks in clear water and on snails till May. From October Rhizoclonium hieroglyphicum appears on the moist soil after rains. Cosmarium, Closterium species occur commonly

from August to October. Euastrum and several desmids appear from August to March, Desmidium which is rare, occurs in February, Spirogyra occurs dominating throughout the year, next only to Oedogonium. The species such as Spirogyra spreeiana, S. submaxima, Zygnama monoiense appear side by side with Spirogyra. Oedocladium, appears on moist soil. Hydrodictyon reticulature, Scenedesmus, Pediastrum sps. appears from September to May. Chara and Nitella begin to appear by mid-July and continues fruiting till they die. They are annuals.

Among Cyanophyceae Aphancapsa, Gloeotheca, Microcystis Microchaete uberima form two generations, the first in September-October and the second in March-May. Fortica bossei var indica was found on the dripping rocks only. Aulosira fruitilissima var tenuis appeared as slimy floating masses in August. A. implexa var crama and A. fertilissima var tenuis are found in August-September in various aquatic habitats.

Calothrix, Gloeotriaechia and Chaetomorpha appear in September-October; species of Scytonema, Petalonema and Tolypothrix appear from June to October. All species of Anaebaena form generations after generations. Nostoc, Spirulina, Oscillatoria are the first algae to appear during rainy season, followed by Phormidium, Lyngbya. Diatoms are particularly abundant from October to March. Euglena and Trachelonema are found throughout the year.

In dried ponds Euglena species, diatoms and Clamydomonas, Spirogyra appear soon after the monsoons.

It will be seen from above that most dominant algae in lakes are Spirogyra and Oedogonium in March. According to Fritsch (1907) species of Oedogonium are quite dominant in tropical pond waters, whereas Cladophora and Rhizoclonium are rather rare. Vaucheria is quite rare, as it requires colder climate. Curiously enough it is abundant at high altitude at Saptashrungi in Nasik and also at Mount Abu. Only one species of Bulbochaecte is found, but rather rare. It grows in clear and flowing water in places where abundant desmids grow.

In Maharashtra there are no large lakes, Rankala (Kolhapur), Venna lake at Mahabaleshwar, Vihar and Tulsi lakes near Bombay and the lake near Buldhana are rather small. But whatever they are, the ecology and succession of algae in them needs to be studied. The growth of important algae in Rankala and other ponds in Kolhapur is given in Table No. II-5.

Since there is no complete list of algae to facilitate the collection and study of their developmental stages, life cycles, the lists of algae of different places from where they are known are given here (See pp. 100-116). There is a gap in our knowledge of the algae in Vidarbha lakes and ponds as also algae from fresh water tanks at Nagpur, Khandesh, Aurangabad and other localities in Marathwada, places on Konkan coast. Maharashtra seems very rich in algae both fresh water as well as marine and also that grow in cool ponds and lakes on hill tops.

9.1. GROWTH OF IMPORTANT ALGAE IN RANKALA AND OTHER PONDS AT KOLHAPUR

TABLE No. II-5

	9	Ğ	GROWTH OF IMPORTANT AL	IMPORTANT ALGAE IN RANKALA AND OTHER PONDS AT KOLHAPUR (AFTER N. D. KAMAT. 1965)	. E	ONDS AT KOLHAPUR (A	FTER N. D. KAMAT. 1965	(
			CHLOROPHYCEAE				CYANOPHYCEAE	
	Name of species		Month of occurrence (2)	Fruiting occurrence (3)		Name of species (4)	Month of occurrence (5)	Fruiting occurrence (6)
-	Volvox sp.	:	September-October	:	15	Microcystis	September to October	1st generation September-October. 2nd generation March-
~	2 Gloeocystis sp	;	January-April	6		A STATE OF THE PERSON OF THE P		May.
3	Tetraspora sp	:	August-September	र्ग स्टब्स् संद्य	16	Fortiea bossei var indica.	:	September-October.
4	Ulothrix sp.	:	July-January	मेव	96	TO SO HANGE		
8	5 Cylindrocapsa	:	Beginning September	End of September to 1st 17 fortnight of October.	11	Aulosira fertilissina V. August tenuis.	:	September-October.
9	6 Oadogonium sp.	:	:	July-May-January	80	Calothrix	Throughout the year September-October.	September-October.
7	7 Oedocladium sp.	:	July	:)		
\$	8 Cosmarium sp	:	July-May	:	61	19 Gloeotrichia	August	September-October.
6	9 Spirogyra sp	:	All the year round	August-May Sentember-October.				•
10	10 Zygnema sp.:	:	Ali the year round	August-September	20	Cylindrospermum sp.	:	August-October.
11	11 Mougeotia sp	:	July cnward	September	22	Nostoc sp Spiruling sp.	Throughout the year.	
12	Sirocladium kumaoense Beginning of August	s	Beginning of August	Late September				
13	13 Nitella sp.	:	Mid July	August		-		
		~						

10. ALGAE FOR FOOD, MANURE AND INDUSTRIAL USES.

Search for new raw materials for food industry is a continuous process in advanced countries. Marine resources of India are being systematically surveyed and tackled only recently since the establishment of the Central Salt and Marine Chemicals Research Institute at Bhavnagar, Central Oceanographic Institute at Goa, and Central National Institute of Fisheries at Cochin. This has been deemed as a step in the right direction; but so far as the plant resources are concerned no significant organised attempts at collection and industrial utilization of algae have been made. Sporadic attempts are made at several places like Okha, Veraval, Vengurla, Malvan, Kottayam, Kanyakumari, Talai Manyar and Cochin, where collections are made by individuals and exported. The main difficulty however, seems to be of not getting any large quantity of drift in bulk necessary for industrial purposes and a guaranteed supply of raw material of algae for extraction. In Maharashtra large quantity of drift is not available as at Kanyakumari or Veraval, nor any systematic attempts for the cultivation of marine algae in rocky pool behind the tidal zones are made. This is possible at certain places like Danda beach at Bombay, Alibag, Malvan, Ratnagiri where seashore is rocky upto Karwar and Goa. But there has been no development in this direction either by the local people or the government. It is known that sea near Malvan, Vengurla is rich in food for animals and plant growth of marine algae.

Attention to this source of raw material for industrial purpose was drawn by Col. Hornell at the suggestion of the late Sayajirao Maharaj of Baroda in his admirably good report on the marine resources of Okha Mandal. After that the only regular work on this important problem is being done on Saurashtra coast by the members of staff of Central Salt and Marine Chemicals Research Institute at Bhavanagar (1970). It is high time that along with the reclamation of Khar lands on the Western coast, attempt be made to explore the possibility of utilization of naturally occurring economic algae e. g. Gracilaria, Hypnea, Sargassum as the raw material for certain industries like iodine, Agar Agar, algin, alginic acid and their derivatives.

Algae constitute the most important food of marine organisms, and also of man. Species of Ulva, Porphyra, Nostoc are used as food since long in China, Japan, parts of India, Scotland etc. They contain good many minerals and vitamins. For example, Microcystis is rich in Vitamin A and Vitamin C. Certain Brown Algae are still richer in them as they contain 17 per cent of aminoacids, 11.6 per cent fat, 54 per cent carbohydrates in various forms of sugar like mannitol 5.37 per cent, Laminarin protein 36 per cent, cellulose 1.9 per cent, algin 50 per cent, all digestible. A look at the analysis of Gracilaria shows how rich it is in Vitamin-B, Carotene, Thiamine and Sulfaflavin, Pyrenoids. contains 15 per cent lipids, 30 per cent proteins, 30 per cent carbohydrates, 5 per cent minerals. It is believed that it is a good source of food for man and cattle. Chlorella ice-cream is served in Japan and in Chinese It is well known that planktonic masses are the chief restaurants. food of marine animals in tropical and sub-tropical sea waters. Similarly in fresh water lakes Oedogonium, Spirogyra, Cladophora, Pithophora, Enteromorpha, Microspora form the food of fishes. In marine plankton Amansia glomerata, Ectocarpus, Hydrocoleus are important food of sea The mineral contents of most of the marine algae are high, but some of them are particularly rich in iodine e. g. Laminaria. According to Van Fallenberg (1926) some aquatic species of Vaucheria also contain: dine. Some algae also serve as good cattle feed.

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10.1. ALGAE AS A RAW MATERIAL FOR INDUSTRIES.

The main products obtained from algae are agar agar from species of Red Algae Hypnea, Gelidium, Gracilaria, Chondrus etc. It is used in medicinal preparations, biological cultures, in cosmetics, in leather and textile industries, for establishing emulsions and suspended solids etc. Some of them like Chondrus crispus also yield complex polysaccharids, but they are mainly exploited for alginic acid and alginates. They are added to ice-cream, cosmetics, printing ink and to rubber tyres. In emulsified form they are used in polish, ice-cream, cheese, jellyes etc.

The fossil diatoms preserved in Palaeozoic deposits as kieselghur are used in dynamite. The palaeozoic oil deposits are rich in a diatom called *Nitzschia*. Algae also are a good source of fertilizers.

Chlorogloia, Fritschiella, Cylindrospermum, Nostoc commune, Anabaena cylindrica, Ulothrix brevissima, Tolypothrix tenuis, Mastigocladus laminosus and Aulosira fertilissima fix atmospheric nitrogen and enrich the wet soil in rice fields.

Certain antibiotics have been reported from Laminaria digitata Polysiphonia species. Chlorella contains an antibiotic called Chlorellin, It inhibits growth of bacteria. Some of them also produce auxins e. g. Microcystis aeruginosa. Ulva lactuca produces IAA type of auxin.

But the main concern of man, especially in large towns, is the question of pollution of water or air, it looms large. Algae like Oscillatoria, Chlorina, Euglena, Spirulina indicate polluted water devoid of oxygen. Chara indicates clear water. Several algae are grown for oxyenation ponds in industrial areas.

Some algae are good soil binding agents. They are good surface binders especially *Nostoc commune*, *Scytonema* and *Anabaena* species. They help to improve the crop soil. It is said that Blue green Algae of rice fields increase nitrogen by nearly 2 per cent.

10.2. Algae and Iodine Industry.

Different Brown and Red algae are known to contain different amounts of Iodine. Generally Brown Algae are better than Red algae—which are better than Green Algae—for this purpose. But of all these, the highest source of iodine are the species of *Laminaria*. They are thrown out on shore during high tide near the high tide mark. Iodine content of marine algae of Gujarat coast is given in Table No. II-6.

TABLE No. II-6

IODINE CONTENT OF MARINE ALGAE OF GUJARAT COAST.

(After Kappana, A. N., Sitakara V. Rao 1962).

Algae (1)		Moisture in he air dried algae % (2)	Iodine/100g. air dried algae mg. (3)
A member of the Custoseiraccae	• •	7,034 16,900 10.010	8,356 28,400 104,500

TABLE No. II-6-contd.

Algae	Moisture in the air dried algae %	Iodine/100g air dried algae mg.
(1)	(2)	
Sargassum cinereum J. Ag. Var. berberifolium	12.200	20.610
Sargassum johnstonii Setch a Gard	16.840	24.460
Spathoglossum variabile Fig. et. De. Not	10.590	16,440
RHODOPHYCEAE		
Acanthophora delilei Lamx	11.620	5.782
Agardhiella tenera (J. Ag.) Schmits	11.090	12.650
Gracilaria folifera (Forssk) Boergs	10.390	15,750
Heterosiphonia muelleri (Sond) De Toni	10.570	10,010
Polysiptonia ferulacea Suhr	5.242	39.060
Polysiphonia sp	7.553	4.781
Saroconema furcellatum Zenard	6,366	8.634
Scinala indica Boergs	11.510	5.621
Sotieria robusta (Grev.) Kylin	5.744	15.540
CHLOROPHYCEAE		
Cladophora manumentalis Boergesen	8,360	59.240
Codium dwarkense Boergesen	4.964	5.051
Ulva lactuca Linnaeus	6.125	1.986
Ulva rigida (C. A. Agardh.) Le Joli	15.200	4.094

10.3. SEA-WATER AND ITS CONTENTS.

According to Encyclopedia of Science and Technology, Vol. 12, p. 108 analysis of sea-water has the following main constituents.

H ² O			96.5
Na		••	1.05
Kg	••	• •	0.04
Mg		• •	0.13
Ca		• •	0.04
Cl			1.9
S			0.09

The sea-water on an average contains up to 2 mg of Iodine per litre mainly in organic form. The species of *Laminaria* of all sea weeds contains the largest amount; but the data, regarding actual percentages in dry weight is variable; for example, according to Kylin stipes of *Laminaria saccharina* contains 0:19 Potassium iodine in the fresh weight, but

in Laminaria gloustoni stipes contains 0.30 per cent. In the members of Fucales it is only 0.02 per cent etc. Iodine is located in special cells (Fritsch, 1945, 2: 34-35).

Sea-water contains several major and minor and trace elements and organic substances. They are extracted from it by processing. Common salt (NaCl) is an outstanding example. Analysis of sea-water which contains several major, minor and trace elements are given on page 96. On an average it contains 3-3.5 per cent of salt all taken together. Its salinity and chlorinity are inter-related.

Sea weeds like *Ulva* contain ascorbic acid. Growth hormones are formed by it. Sea farming is not common in India as in Japan, for food from sea weeds, for pearl fisheries, for preparing manure etc. Other products such as Agar-agar, alginic acid are obtained from sea weeds. Of various products from sea weeds next to Iodine Agar-agar from Red Algae and alginic acid from Brown algae are more important.

They also are rich in proteins and as such are good supplementary feed for cattle.

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- Algae of Different Places and Regions are Given Next In No. 11-19

11. ALGAE OF BOMBAY

EUGLENOPHYTA

Family Euglenaceae

- 1. Genus Euglena
 - (1) Euglena acus Ehren
 - (2) E. charkowiensis Swir
 - (4) E. fusca (Klebs) Lemmermann
 - (4) E. gibbosa Schiller
 - (5) E. pusilla Palyfair v. longa Playfair
- 2. Lepoeinclis ovum (Ehren.) Lemm.
- 3. Genus Phacus
 - (1) Phacus caudatus Hubner
 - (2) P. caunvicauad Swirenke
 - (3) P. hameli Allorge et Lefevre
 - (4) P. helikoides Pochm
 - (5) P. longicauda (E) Dujardin
 - (6) P. maharashtrensis Kamat
 - (7) P. orbicularis Hubner
 - (8) P. pekinenis Skvorts
 - (9) P. pleuromectus (O. F. M.) Dujardin
 - (10) P. tortus (Lemm.) Skv.
 - (11) P. triqueter (E) Dujardin
- 4. Genus Trachelomonas
 - (1) T. abrupta Swir emend Deflandre v. minor Deflandre
 - (2) T. armata (E.) Stein
 - (3) T. armata (E.) Stein V. steinii Lemm. emend. Deflandre
 - (4) T. dybowskii Drez.
 - (5) T. hexangulata (Swir.) Playfair
 - (6) T. hispida (Perty) Stein emend. Deflandre
 - (7) T. oblonga Lemm. v. Major Kamat
 - (8) T. volvocina Ehrenberg
 - (9) T. volvocina Ehrenberg V. derephora Gonrad
 - (10) T. vol ii Lemm. V. cylindrica Playfair
 - (11) T. woycickii Koczware v. bombayensis Kamat

CHLOROPHYTA

Family Ulvaceae

- 5. Genus Ulva
 - (1) U. lactuca (L.) Le Jolis
 - (2) U. reticulata Forssk
- 6. Genus Enteromerpha
 - (1) E. flexuosa (Wulf.) J. Ag.
 - (2) E. tubulosa Kuetz.
 - (3) E. prolifera (Fl. Dan.) J. Ag.
- 7. Genus Entocladia
 - (1) E. immanes elimidle
 - (2) E. leptochaete haber

Family Valoniaceae

- 8. Genus Valonia
 - (1) V. aegagraphila C. Ag.
 - (2) V. utricularis (Both.) Ag.

Family Cladophoraceae

- 9. Genus Rhizoclonium
 - (1) R. kochianum Kuetz.
 - (2) R. grande Boergs
- 10. Genus Chaetomarpha
 - (1) C. indica (Muell.) Kuetz.
 - (2) C. area (Dillw.) Kuetz.
 - (3) C. antennina (Eory) Kuetz.
 - (4) C. clavata (Ag.) Kuetz.
- 11. Genus Lola
 - (1) L. capillaris (Kuetz.) A. et. G. Hamel
- 12. Genus Cladophora
 - (1) C. saracenica Boergs
 - (2) C. colobense Boergs
 - (3) C. bomboyensis Boergs
 - (4) C. monumentalis Boergs
 - (5) C. crispata Boergs
 - (6) C. fascicularis Mertens

Family Palmellaceae

- 13. Genus Gloeocystis
 - (1) G. aempla (Kuetz.) Langerheim.
 - (2) G. gigas (Kuetz.) Langerheim.

Family Protococcaceae

14. Genus Protococcus

P. vindus Agardh

Family Siphonocladiaceae

15. Genus Strukea

(1) S. delicatula Kuetz.

Family Bryopsidaceae

16. Pseudobryopsis mucronata

PHAEOPHYTA

Family Ectocarpaceae

17. Genus Ectocarous Kuetz.

(1) E. irregularis Kuetz.

Family Sphacelariaceae

18. Genus Sphacelaria

(1) S. furcigera Kuetz.

Family Dictyotaceae

19. Genus Dictyopteris

- (1) D. acrostichoides 1. Ag.
- (2) D. bartayresiana Lamour.
- (3) D. dumosa Boerg.
- (4) D. maxima Zan.
- (5) D. atomaria Hauck.
- (6) D. pinnatifida Kuetz.
- 20. Genus Dilophus
 - (1) D. fascida (Roth) Howe.
- 21. Genus Spathoglossum
 - (1) S. asperum J. Ag.
- 22. Genus Stoechospermum

S. marginatum (Ag.) Kuetz

- 23. Genus Padina
 - (1) P. tetrastromatica Hauck.

Family Chordariaceae

24. Genus Myriactula

(1) Myriactula arabica (Kuetz) Feldm.

Family Spermatochnaceae

25. Genus Nemacystus

(1) N. decipiens (Sur.) Kuck.

Family Punctariaceae

- 26. Genus Rosenvingea
 - (1) R. intricata (J. Ag.) Boergs,
- 27. Genus Colpomenia
 - (1) C. sinuosa (Roth.) Derb. et. Sol.

Family Sargassaceae

- 28. Genus Cystophyllum
 - (1) Cystophyllum muricatum (Turn.) J. Ag.
- 29. Genus Sargassum
 - (1) S. cinereum J. Ag. var. berberifolia Grun.
 - (2) S. ilicifolium (Turn.) C. Ag. var. vanusta Grun.

RHODOPHYTA

Family Bangiaceae

- 30. Genus Erythrotrichis
 - (1) E. camea J. Ag.
- 31. Goniotrichum
 - (1) G. elegans (Chauv.) Le Jolis

Family Chantransiaceae

- 32. Genus Acrochaetium
 - (1) A. sargassicolum Boergs.
- 33. Genus Liagora
 - (1) L. ceranoides Lamx.
- 34. Genus Scinia
 - (1) S. hatei Boergs.
 - (2) S. indica Boergs,

Family Gelidiaceae

- 35. Genus Gelidium
 - (1) G. pusillum (Stackh.) Le Jolis
 - (2) G. pulvinatum (Kuetz.) Thur. forma parivssima
 - (3) G. heteroplastos Boergs.
 - (4) G. corneum (Huds.) Lamour.
- 36. Genus Gelidiopsis
 - (1) G. variabilis (Grev.) Schmitz.
 - (2) G. myriocladia Boergs. Feldm. et Hamel.
- 37. Genus Gelidiella
 - (1) G. acerosum (Forssk.) Feldm. et Hamel.
- 38. Genus Caulacanthus
 - (1) C. ustulatus (Mert.) Kuetz.

Family Squamariaceae

- 39. Genus Peyssonnelia
 - P. obscura Web.
 - P. bosse var. bombayensis Boergs.
- 40. Genus Cruoriella
 - C. bicolor Boergs.
- 41. Genus Hildenbrandia
 - H. prototypus Nardo.

Family Corallina

42. Genus Amphiroa
A. frogilissima (L) Lamour.

43. Genus Cheilosporum
C. spectabile Harv.

44. Genus Jania

J. rubens (L.) Lamour.

Family Solieriaceae

45. Genus Solieria

(1) S. robusta (Grev.) Kuln, var. waghtii.

46. Genus Sarconema

S. furcatum Boergs.

47. Genus Agardhiella

A. robusta (Grev.) Boergs.

Family Rhabdoniaceae

48. Genus Catenella

C. repens (Light.) Batt.

Family Hypneaceae

49. Genus Hypnea

(1) H. velenliae (Turn.) Mont.

Family Sphaerococcaceae

50. Genus Chrysymenia

(1) C. uvaria (L.) Jag. forma. luxuriana Boergs.

Family Gracilariaceae

51. Genus Gracilaria

(1) G. folifera (Forssk.) Boergs.

(2) G. corticata var. ramalinoides J. Ag.

Family Gigartinaceae

52. Genus Gigartina

(1) G. acicularis (Wulf.) Lamour.

Family Rhodymeniaceae

53. Genus Botryocladia

(1) B. leptopoda (J. Ag.) Kylin.

Family Champiaceae

54. Genus Champia

- (1) C. somalensis Hauck.
- (2) C. indica Boergs.
- 55. Genus Rhodymenia
 Rhodymenia australis Sond.

Family Geramiaceae

- 56. Genus Monospora
 - (1) M. indica Boergs.
- 57. Genus Ceotrocespas

C. filamentosa (Wulf.) Harv.

- 58. Genus Spyridia
 - S. filamentosa (Wulf.) Harv.
- 59. Genus Griffithsia
 - (1) G. duperreyi Mont.
 - (2) G. flabelliformis Harv.
- 60. Genus-Cautroceras
 - (1) C. clavaulatum (Ag.) Mont.

Family Delesseriaceae

- 61. Genus Myriogramme
 - (1) M. bombayensis Boergs
- 62. Genus Caloglossa
 - (1) C. leprienrii (Mont.)
 - (2) C. bombayensis Boergs.

Family Rhodomelaceae

- 63. Genus Laurencia
 - (1) L. papillosa (Forssk.) Grev.
 - (2) L. obtusa (Huds.) Lam. var. diverticata Harv.
 - (3) L. majuscula Harv.
 - (4) L. pedicularioides Boergs.
- 64. Genus Chondria
 - (1) C. dasypylla (Woodw.) Ag.
 - (2) C. cornuta Boergs.
- 65. Genus Acanthophora

A. dendroides Harv.

- 66. Genus Polysiphonia
 - (1) P. platycarpa Boergs.
 - (2) P. variegata (C. Ag.) Zan.
 - (3) P. Ferulaceae Suhr.
- 67. Genus Roschera
 - R. glomerulata (C. Ag.) Web.

V. Bosse.

- 68. Genus Leveillea
 - L. jungermannioides (Mart. et. Her.) Harv.

Family Dasyaceae

- 69. Genus Heterosiphonia
 - (1) H. muelleri (Sond.) De Toni
 - (2) H. wurdemann. (Baill). Falkb. var laxa Boergs.

70. Genus Falkenbergia

(1) F. ruf anulosa (Harv.) Schmitz.

12. ALGAE OF ALIBAG

(After N. D. Kamat, 1968, J. B. N. S. 65: 88-104)

CYANOPHYTA

Family Chroococcaceae

Name

Habitat and Locality

- 1. Genus Microcystis
 - (1) M. aeruginosa Kuetz .. Common in puddles, ponds.
 - (2) M. flos-aquae (Wittr.) In pools, ponds, Alibag, Poynad Kirchn.
- 2. Genus Merismopedi
 - (1) M. glauca (Ehr.) Naeg. In brackish water ponds, Koproli
 - (2) M. tenuissima Lemm In ponds.
 - (3) M. punctata Mayen .. In ponds, Koproli
- 3. Genus Chroococcus:
 - (1) C. tenax (Kirch.)—In paddy fields, Saral, Zirad, Hieron.
 - (2) C. turgidus (Kuetz.)—Rare.—In paddy fields, Saral Nag.

Family Oscillatoriaceae

सत्यमेव जयते

- 4. Genus Oscillatoria
 - (1) O. amphiba Agardh .. In a rackish water outlet, Rewas
 - (2) O. annae van Goot .. In Khar paddy fields, Poynad.
 - (3) O. brevis (Kuetz.) Gom. In
- In brackish water outlet, Rewas.
- In a gutter, Saral; with Calyptera.
- (4) O. chalybsa(Mar.)Gom.
- (5) O. claricentrosa Gard
- In paddy fields, Saral.

 In paddy fields, Zirad, on the
- (6) O. formosa Berry .
- n paddy neids, Zirad, on the dam wall Tinviza.
- (7) O. limosa Agardh .
- In brackish water outlet, Rewas
- (8) O. mougeiotii Kuetz . .
- Planktonic in a Bodhan,* Koproli-
- (9) O. pseudogenubata G. Schmid.
- In Khar paddy fields, Rewas.
- (10) O. pseudogeminata G. Schmid v. unigranulata Biswas.
- Planktonic in a Bodhan* Koproli.
- (11) O. pseudogeminata G. Schmid v. unigranulata Biswas.

In Khar paddy field, Rewas. In the mucilageneous masses of Gloeotrichia in a paddy field, Thal.

^{*}Bodhan means stone bund.

Name

Habitat and Locality

- (12) O. rebescens D. C. ex On moist soil near a gutter, Gom. f. ahmedaba- Saral. densis Kamat.
- (13) O. schultzii Lemm. v. In a gutter, Saral. cyclinadrica Kamat.

5. Genus Lyngbya

- (1) L. aerugineo-coerulea In the mucilagenous masses of Aphanotheca sp. in a paddy fields.
- (2) L. majuscula Harvey ex In a pond, Saral.
- (3) L. palmarum (Mart) On stones in a fast running Bruehl et Biswas. streamlet, Saral.
- (4) L. perelegans Lemm .. In Khar paddy field, Rewas,
- (5) L. polysiphona Fremy . . In a streamlet, Saral.
- (6) L. semilplena (Agardh) In a puddle, paddy fields, Koproli. J. Ag. ex. Gom. Saral.
- (7) L. shacklton W. et. G. S. In a Bodhan, Satghar. West.

6. Genus Symploca

- (1) S. muscorum (Agardh) On moist soil near a wall, Saral.
 Gom.
- 7. Genus Polychlamydum
 - (1) P. insigne W. et. G. S. Planktonic in Khar paddy fields, West. Rewas, Shahabag.
- 8. Genus Microcoleus

M. chthonoplastes Thuret In paddy fields, Rewas.

सत्यमव जयत

- 9. Genus Schizothrix
 - (1) S. mexicana Gom. .. On stones in a fast running streamlet, Saral.
 - (2) S. porphyromelana ln a fast running streamlet, Zirad Bruehl et Biswas.

Euglenophyceae

- 1. Genus Euglens
 - (1) E. acus Ehr. .. Common in bodhans.
 - (2) E. proxima Dong .. In a Bodhan, Koproli.
- 2. Genus Phacus:
 - (1) P. acuminatus Stok .. In the ponds, Thal, Awas.
 - (2) P. acuminatus Stok. In a pond, Dhokavade. v. triqueter (E.) Dujardin.

Habitat and Locality

(3) P. caudata Hub		In a po	nd, Awas.
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- (4) P, helikoides Poch In the ponds, Awas, Thal.
- (5) P. longicuada (E) Duj. . . In a pond, Thal.
- (6) P. meson Poch.. ln a pond, Mapagaon.
- (7) P. orbicularis Hubner... In a pond, Dhokawade.

3. Genus Lepocinclis

- (1) L. acuta Pres ... In a pond, Thal.
- (2) L. ovum (Ehr.) Lemm. In a pond, Awas.
- (3) L. ovum (Ehr.) Lemm. In a pond, Awas. v. dimidio minor Defl.

4. Genus Trachelomonas

- (1) T. armata (Ehr.) Stein In Bodhan, Koproli. v. steinii Lemm. emend. Defl.
- (2) T. bulla Stien emend. Defl.
- In a pond, Dhokavade.
- In a paddy fields, Rewas. (3) T. klebsii Defl. ... In a Bodhan, Zirad. (4) T. oblonga Lemm.
 - v. truncata Lemm.
- Common in bodhans and ponds.
- (5) T. volvocina Ehr. (6) T. volvocina Ehr. In a pond, Mapagaon.
 - v. punctata Playf.
- (7) T. woycikii Koez. In a pond, Thal.

CHLOROPHYTA

Family Ulvaceae

Genus Enteromorpha

.. Attached to stone in a streamlet (1) E. prolifera. Ag.

Family Chaetophoraceae

2. Genus Chaetophora

- (1) C. elegans (Roth.) .. Adhering to stones in a paddy field outlet, Hashivare. Agardh.
- (2) C. pisciformis (Roth) Common in paddy fields and streamlets. Agardh.

3. Genus Stigeoclonium

(1) S. tenus (Agardh) .. In a pond, Dhokavade. Kuetz.

Family Cladophoraceae

4. Genus Cladophora

- Attached to stones in a streamlet, (1) C. glomerata (L.) Kuetz. Saral.
- 5. Genus Pithophora
 - (1) P. oedogonia (Mont) . . In a well, Poynad. Wittr.

Genus Rhizoclonium

Planktonic in Khar paddy fields. (1) R. hieroglyphicum (Agardh) Kuetz. . .

Family Coleochaetaceae

- - (1) C. irregularis Prings .. Epiphytic on Nitella sp. in a pond, Kihim.
 - (2) C. orbicularis Prings .. Epiphytic on Nitella sp. in a pond, Kihim.

Family Protococcaceae

- 8. Genus Protococcus
 - (1) P. viridis Agardh ... On the leaves of Sapota, Mangifera, and on moist earthern pots.

Family Oedogoniaceae

- 9. Genus Oedogonium
 - (1) O. ahlstrandii Wittr. ex Epiphytic on Chara sp in a pond, in Kihim.
 - (2) O. amomalum Hirn .. In a pool in a streamlet, Mapagaon.
 - (3) O. zexuosum Hirn. .. In a slightly brackish water pond, Koproli.
 - (4) O. pratense Trans .. In a pool, Saral.
 - (5) O. subsexangulare Tiff Epiphytic on Chara in a pond, Kihim.
 - (6) O. tapeinosporum Wittr. Attached to submerged cement ex. Hirn. wallin a pond, Mapagaon.
 - (7) O. varians Wittr. ex In a pool, Saral. Hirn.
 - (8) O. vaucherii (Le Clero) Epiphytic on Chara sp. in a pond, Al. Braun. Kihim.
 - (9) O. virceburgense Hirn Epiphytic on Chara sp. in a pond, Kihim.

Family Hydrodictyaceae

- 10. Genus Pediastrum
 - (1) P. duplex Meyen .. In a pond, Dhokavade. v. cohaerens Bohlin.
 - (2) P. duplex Meyen, In a pond, That. v. reticulatum Lag.
 - (3) P. simplex (Meyen), Common in ponds, puddles. Lemm.
 - (4) P. tetras (Ehr.) Ralfs Common in ponds.
 - (5) P. tetras (Ehr.) Ralfs. In a pond, Awas. v,. tetradron (Corda). Rab.

Family Oocystaceae

- 11. Genus Ankistrodemus
 - (1) A. convolutus Corda .. In a pond, Awas.
 - (2) A. falcatus (Corda) Ralfs Common in ponds.
 - (3) A. falcatus (Corda) In a pond, Awas. Ralfs v. tumldus G. S.
 West.
 - (4) A. spiralis (Turn) Lemm. In a pond, Thal.

Habitat and Locality

12. Genus Oocystis (1) O. borgei Snow .. Common in ponds (2) O. elliptica W. West.. In a pond, Thal Genus Dimorphococcus 13. (1) D. lunatus A. Br. .. In a pond, Thal 14. Genus Selenastrum (1) S. guacile Reinsh .. In a pond, Dhokavade 15. Genus Tetraedron (1) T. trigonum (Nacg.) In paddy fields Hansg. Family Scenedesmaceae 16. Genus Scenedesmus (1) S. arcuatus Lemm. In a pond, Awas v. platvdiscus G. M. Smith. (2) S. bijuga (Turp.) Lag Common in ponds (3) S. denticulatus Lag ... In a pond, Awas (4) S. falcatus Chodat ... In a pond, Dhokavade (5) S. incrassatulus Bohlin On a dam, Tinvira v. momonae G. M. Smith. (6) S. opoliensis P. Richer In a pond, Dhokavade Family Desmidiaceae Genus Closterium 17. (1) C. acutum Breb In a pond, Thal (2) C. cornu Ehr In a pond, Poynad (3) C. dianae Ehr. In a pond, Thal (4) C. dianae Ehr. v. minus In a pond, Thal (Wille) Schred. (5) C. gracile Breb In a pond, Thal (6) C. gracile Breb In a pond, That v. intermedium Ralf. (7) C. kuetzingii Breb . . In a pond, Thal In paddy fields, Saral (8) C. parvulum Naeg . . (9) C. parvulum Naeg In a puddle, Mapagaon v. angustum W. et. G. S West. (10) C. venus Kuetz In a paddy fields, Saral (11) C. venus v. incurvum In a pond, Kihim. (Breb.) Krieg. 18. Genus Cosmarium (1) C. amoenum Breb .. In a pond, Dhokavade (2) C. angulosum Breb ... In a pond, Kihim v. concinnum (Raben.) W.et. G. S. West. (3) C. bengulense (Grun.) In a pond, Dhokavade. Turn.

Habitat and Locality

- (4) C. bioculatum Breb In a pond, Awas v. hians W. et. G. S. West.
- (5) C. contractum Kirch In a pond, Dhokavade
- (6) C. cyclicum Lund In a pond, Kihim f. crenulatum Kamat.
- (7) C. depressum (Naeg.) In a pond, Kihim Lund. v. planktonicum
 Rev.
- (8) C. furcatospermum W.et In paddy fields, Saral G. S. West v. koreanum Skv.
- (9) C. impressulum Elfv

In a pond, Kihim

- (10) C. laeve Rab
- In a paddy fields. Saral
- (11) C. laeve Rab v. reniferme Hir.
- In mucilaginous mass on dripping wall at Tinvira. In a pond, Awas.
- (12) C. margaritatum (Lvnd) In a pend, Kihim Roy et Bisset. f. minor (Boldt) W. et G. S. West.
- (13) C. meneghinii Breb .. In the ponds, Awas, Kihim
- (14) C. moniliforme (Trup.) In a pond, Thal Ralfs.
- (15) C. occultum Schm .. In a pond, Kihim
- (16) C. perincissum Gron In a pond, Kihim v. ahmedabadense Kamat.
- (17) C. portianum Arch .. In a pond, Kihim.
- (18) C. punctulatum Breb. In a paddy field, Saral V. subpunctulatum (Nord.) Boerg.
- (19) C. rectangulare Grunn In a pond, Kihim v. africanum W. et G. S. West.
- (20) C. reniforme (Ralfs) In a pond, Kihim Arch. v. conpreasum
 Nord.
- (21) C. sikhimense Turn .. In a pond, Kihim
- (22) C. subturgidum (Turn.) In a pond, Thal Schm. f. minor Schm.
- (23) C. subtumidum Nord In a pond, Kihim v. klebsii (Gutw.) W. et. G. S. West.
- (24) C. tithophorum Nord. In a pond, Thal v. minor Rac.

19. Genus Euastrum

(1) E. denticlatum (Kirch.) In a pond, Kihim Gay v. rectangulare W, et. G. S. West.

Habitat and Locality

- (2) E. dubicum Naeg. In a pond, Thal v. tritum W. et. G. S. West.
- (3) E. irregulare Gonz. et On Tinvira Dam. Gang.
- (4) E. spinulosum Defl . . On Tinvira Dam.
- (5) E. Subalpinum Messik In a pond, Dhokavade.
- (6) E. substellatum Nord In a pond, Kihim
- 20. Genus Staurastrum
 - (1) S. deiectum Berb .. In a pond, Thal
 - (2) S. oxyacauthum Arch In a pond, Thal
- 21. Genus Desmidium
 - (1) D. aptogonum Breb In a pond, Thal v. ehrenbergii Kuetz.

Family Zygnemataceae

- 22. Genus Zygnema
 - (1) Z. czurdas Randh ... In a paddy field, Saral
 - (2) Z. gangeticum Rao .. Adhering to stones or free floating in a streamlet, Tinvira.
 - (3) Z. hypnosporum Rich Planktonic in paddy fields on hills, Saral.
- 23. Genus Spirogyra
 - (1) S. daedaloide Czurda Floating masses in a pond, Kihim.
 - (2) S. hyalina Cleve ... Common in ponds, paddy fields.
 - (3) S. hymerae Britt, ct In a pond, Mapagaon Smith.
 - (4) S. singularis Nord .. In a streamlet, Saral

CHAROPHYCEAE

Family Characeae

- 1. Genus Nitella
 - (1) N. acuminata A. Braun Gommon in ponds, Awas, Zirad, Kihim, Thal.
 - (2) N. axillaris Braun .. In a pond, Kihim
 - (3) N. furcata (Roxb. apod In ponds, Kihim, Awas Bruz.) Agardh.
 - (4) N. hyalina (D.C.) Very common in Khar, paddy Agardh. fields and in ponds.
 - (5) N. watti J. Grov .. In a pond, Mapagaon
- 2. Genus Chara
 - (1) C. benthamii A. Braun In a pond, Kihim
 - (2) C. brachypus Braun .. Common in ponds, paddy fields
 - (3) C. corallina Willd .. Common in ponds
 - (4) C. pseudobrachypus In ponds, Saral, Awas Grov. et Steph.
 - (5) C. zeylanica Willd .. Very common and very variable species in Khar, paddy fields, ponds, pools.

13. ALGAE OF RATNAGIRI AND MALVAN

Family Ectocarpaceae

1. Genus Ectocarpus

E. compger Lynbye

Family Dictyotaceae

2. Genus Dictyopteris

D. woodwardii (Br.) J. Ag.

- 3. Genus Spatoglossum (Brown) Ag. S. marginatum (Ag.) Kuetz.
- 4. Genus Padina

P. tetrastromatica Hauck.

5. Genus Pocockiella Pocockiella sp.

Family Punctariaceae

6. Colpomenia

C. sinuosa (Roth) Derb. et Sol.

14. ALGAE OF PUNE

CYANOPHYTA

Family Chroococcaceae

1. Genus Gloeocapsa

G. crepidinum Thuret

Crust forming alga, Poona.

2. Genus Merismopedia

M. minima Beck

3. Genus Gloeothece

G. rupestris (Lyng.) Born.

4. Genus Microcystis

M. aeruginosa (Kuetz.)

- 5. Genus Scytonema
 - S. hansgirgi Schmidle
 - S. pseudohofmanni Bharadw.

Family Nostochopsidaceae

6. Genus Stigonema

S. ocellatum (Dillw.) Thuret In paddy fields at Poona.

Family Nostocaceae

7. Genus Nostoc

N. microscopicum Carm.

8. Genus Nostochopsis

N. lobatus Wood emend. Geitler

- 9. Genus Anabaena
 - (1) A. spiroides Kelb.
 - (2) A. laxa (Rabenh.) A. Br. In Western Ghats, Poona.

A-127-8-A

Family Oscillatoriaceae

- 10. Genus Oscillatoria
 - (1) O. personata Skuja
 - (2) O. serpentina Richler
- 11. Genus Lyngbuya
 - L. majuscula Harv.
- 12. Genus Phormidium Kuetz.
 - (1) Phormidium sp.

On tree trunks at Poona.

CHLOROPHYTA

Family Euglenaceae

1. Genus Eaglena

E. acus Ehrenb

Family Chaetophoraceae

- 2. Genus Chaetophora
 - C. elegans (Roth) Agardh
- 3. Genus Chaetonema
 Chaetonemairregulare
 Meyen
- 4. Genus Stigeoclonium Stigeoclonium sp.
- 5. Genus Achanochaete
 - A. polychactte (Hansg.) Fritsch
- 6. Genus Fristchiella Nordst
 - F. tuberosa lyengar

Family Cladophoraceae

7. Genus Rhizoclonium

R. hierogyphicum Kuetz

Family Chlamydomonadaceae

- 8. Genus Chlamydomonas sp. Chlamydomonas sp.
- 9. Genus Sphaerellopsis S. Fluviatilis Pardllan
- 10. Genus Carteria
 C. ovata Jacobsen
- 11. Genus Chlorogonium C. tetragemium
- 12. Genus *Pamlorina P. marum* (Muell.) Bory.
- 13. Genus Eudorina E. elegans Ehrenb
- 14. Genus Volvox

A-127-8-B.

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- (1) V. poonaensis Apte
- (2) V. dissibatrix (Shaw)
- (3) V. prolificus Iyengar

Family Chlorococaceae

ALGAE

- 15. Genus Chlorococcus Chlorococcus sp.
- 16. Genus Chalorella C. vulgaris Beji.
- 17. Genus Actinostrum
 A. hantzschii Lagerh
- 18. Genus Kirchneriella

 K. lunaris (Krichn.) Moeb.
- 19. Genus Sorashtrum Sorashtrum sp.
- 20. Genus Micractinium:
 - (1) M. guadriselem Lemn.
 - (2) Micractinium sp.
- 21. Genus Trebauxia Trebauxia sp.
- 22. Genus Protosiphon
 P. botryoides (Kuetz.) Klebs

Family Ulotricaceae

- 23. Ulothrix Zonata (Klebs)
- 24. Genus Hormidium
 H. Flaccidum (Kuetz.) Br.

Family Sphaeropleaceae

25. Genus Sphaeroplea S. annulina (Roth) Ag.

Family Ulvaceae

- 26. Genus Ulva
 - (1) U. farceala Delice
 - (2) U. reticulata Forssk
 - (3) U. lactuca L.

Family Tentapohliaceae

- 27. Genus Gongroma
 G. circinata (Borzi) Schmidle
- 28. Genus Cephaluros
 C. virescens Kunze
- 29. Genus Pleurococcus P. naegelii. Chod.

Family Palmellaceae

- 30. Genus Sphaerocystis
 - S. schroeteri
- 31. Genus Pediastrum
 P. duplex Meyer
- 32. Genus Westella
 W. botryoides Wildem

Family Oedogoniaceae

33. Genus Oedogonium
O. capillare Kuetz.

Family Hydrodictyaceae

- 34. Genus Hydrodictyon
 H. reticulatum (L.) Lagerh,
- 35. Genus Pediastrum
 P. simplex Meyer

Family Oocystaceae

- 36. Genus Ankistrodesmus

 A. falcatus (Corda) Ralfs.
- 37. Genus Dimorphococcus
 D. Junatus A. Br.
- 38. Genus Tetrastrum
 T. elegans Playfair
- 39. Genus Closterium

 C. moniliferum Ehrenb.

Family Zygnemataceae

- 40. Genus Spirogyra Spirogyra spp.
- 41. Genus Zygnema Zygnema spp.

14-1. ALGAE OF PUNE AND VICINITY

There are several algae at places near about Pune. Of these flora of ponds and tanks on the Purandar hill-fort, about 35.2 km., and in the pond at Bhosari is very interesting. It is from here that Apte (1936) reported species of *Volvox*. They perennate even if the ponds dry. The other algae found at Purandar are:—

Crucigenia cruciata, Kirchneriella lunaris, Ankistrodesmus falcatus, Sirogonium sticticum, Sirocladium maharashtrense, Vaucheria sessilis, species of Cosmarium, Coclastrum, Euastrum, Fragillaria, Staurastrum, Chlorella, Chlorococcum, Pennularia, Navicula Characiosiphon.

In the Mutha river with flowing water during the months of October-November one finds a species of Bulbochaete. On the margins of drying ponds near river on the silt one finds Botrydium. It will be seen from above the Pune is very rich in fresh water algae and it would be worthwhile investigating them thoroughly throughout occurring the year and compare them with those in other places like Kolhapur. In the early months of the monsoons one notices several species of Spirogyra and

later Oedogonium. The latter persists even during the dry months, should some water be available in the pond. They practically dominate the flora of the pond.

The list of other known algae is given below.

Algae of Pune Proper:

Pune stands at the confluence of the two small uphill rivers Mula and Mutha, rich in varied green and blue green algae. There are a few small lakes, which supply water to Pune at Katraj and Pashan and a number of small and large ponds having permanent sheets of water. Some are temporary monsoon ponds. They all contain a number of algae not fully investigated. From available information some of them are given below. They are all fresh water algae collected occasionally and not throughout the year.

14.2. ALGAE OF GANESHKHIND BOTANICAL GARDEN POND, ETC

This contains Tetraedron trigonum, Pediastrum duplex, Ankistrodesmus falcatus, Tetraspora lammermannii, Scenedesmus quadricuada, Merismopedia glauca, Gleocystis ampla, Oscillatoria perornata, Pennularia viridis, Rhopalodia biloba, Nephrocytium agardhianum, Fritschiella tuberosa, Protosiphon botryoidis and species of Asterococcus, Anabaena, Desmidium, Closterium, Straurastrum, Straurodesmus, Cosmarium Pleurotenium, Chlamydomonas, Navicula, Ulothrix, Stigeoclonium, Mougeotia, Peridinium, Gymnodinium etc.

There is a small pond at Kirkee on way to Kirkee station from Ganesh-khind Botanical Garden. It is a rain water pond, but never dries up. It contains Pandorina murum, Nephrocytium lunatum, Coelosphaerium nagetlanum Cylindrospermum gorakhporense, Botryococcus braunii, Aphanochaetae rapense, Schizomeris leiblenii. Species of Volvox, Bulbochaetae, Uronema, Oedogonium, Zygnema etc.

The small lily pond in the Poona University campus garden has the following algae:—

Microcoleus, Echthonoplostes, and species of Trebauxia, Pleurococcus, Haplosiphon.

Swimming pool on the Pune University campus has Scenedesmus dimorphus, Sirocladium maharashtraense and species of Colastrum, Chrococcus.

A little further in a pond at Chatushringi the flora consists of Eudorina elegans, Pediastrum boryeneum, Pediastrum tetrasvar, tetrahydron and species of Lyngbya, Cyclotella, Hormidium peranema, Westella, Oocystis Characium. Occasionally one comes across a species of Gongrosera growing on the shells of water snails in the pond in the quarry of Gokhale nagar near Mhasoba Chouki.

15. ALGAE OF KOLHAPUR

(After N. D. Kamat, 1963, Hydrobiologia-22 (3-4) 209-305)

CYANOPHYTA

Family Chroococcaceae

Name

Habitat and Locality

1. Genus Microcystis

- (1) M. aeruginesa Kuetzing Common in puddles, ponds (throughout the year).
- (2) M. flosaquae (Wittr.) In a pond, (5-11-53). Kirchner along with M. aeruginosa.

Habitat and Locality

- (3) M. Pesudofilamentosa Crow.
- In a puddle, Rankala side (5-10-55).
- (4) M. scripta (Richter) In a pond, Shahupuri (5-10-53) Lemm.
- 2. Genus Aphanocapsa
 - (1) A. biformis A. Br. .. In dripping walls, (19-7-53).
 - (2) A. fenticola Hansgirg In a streamlet, Takala (12-7-53).
 - (3) A. grevillei Rabenhorst In a streamlet, Takala (12-7-53).
 - (4) A. montana Cramer ... On dripping rocks, (19-7-1953).
 - (5) A. muscicola Meheghini On dripping rocks, (19-7-1953).
 - (6) A. nivalis Lagerheim . On dripping rock, (19-7-1953).
- 3. Genus Aphanothece
 - (1) A. castagnei (Breb.) . . Common on dripping rocks Rabenhorst, barks of trees (July-August).
 - (2) A. microscopica Naegeli In a pond, (6-3-1954).
 - (3) A. naegeli Wartm ... In puddle, Takala; Rankala lake side (30-8-1953).
 - (4) A. pallida (Kuetzing)

 Rabenhorst.

 Common in globular amorphous masses in paddy fields, pouds;

 On moist soils, dripping rocks.
 on barks of Banyan trees etc.
 (throughout the year).
 - (5) A. saxicola Naeg ... On dripping rocks, (19-7-53).
- 4. Genus Gloeotheca
 - (1) G. geoppertiana (Hilse) On dripping rocks, (19-7-1953).
 - (2) G. membranacea (Rabenhorst) Bornet. On dripping soil near streamlet, Takala (20-7-1953).
 - (3) G. pales (Kuetzing) On moist soil near streamlet Rabenh. Takala (20-7-1953).
- 5. Genus Chroococcus Naegeli
 - (1) C. minutus (Kuetzing) In a well, Takala (6-3-1954). Naegeli.
 - (2) C. spelaeus Erceg ... In a pond, Takala (6-3-1954).
- 6. Genus Coelosphaerium Naegeli Coelosphaerium goetzi Schemidle.
- 7. Genus Merismopedia Meyen
 - (1) Merismopedia glauca Common in puddles and ponds, (Ehrenberg). (Jan.-May).
 - (Jan.-May).

 The algae was found always in
 - (2) M. marssonii Lemmer- The algae was found always colonies of four cells only.
 - (3) M. tenuissima Lemm.. Common in puddles (January-March).

Name

Habitat and Locality

sp.

in

8. Family Microchaetaceae.

Genus Microchaete

Common on moist soil, on moist M. uberrima Nacarter of a house, Takala, puddles, ponds, (5-7-53). In

(5-9-53), (5-10-53), (5-5-1954).

9. Genus Aulosira Kirchner

- In puddles by Rankala (1) A. fertilissima Ghose side v. tenuis C. B. Rao. (8-8-53).
- Common in puddles, ponds, on (2) A. implexa Bornet et. Flahault v. crassa Dixit moist soil (August-September).

Family Rivulariaceae

10. Genus Calothrix Agardh

- (1) C. fusca (Kuetzing) Common on dripping rocks. Bornet and Flahault. (10-10-53). On stones in a puddle Rankala lake side (8-1-1954).
- (2) C. karnatakensis Gonmucilagenous masses In zalves and Kamat. Chaetophora sp. in a puddle, (2-9-1953).
- (3) C. karnatakensis Gon-Embedded in the gelatinous mass zalves and Kamat. of Gloeotrichia sp. in a puddle, v. major Gonzalves & (5-2-1954).Kamat.
- (4) C. karnatakensis Gon- Epiphytic Chara on zalves and Kamat v. Rankala lake (5-10-1953). Major Gonzalves and Kamat. varians Gonzalves and Kamat.
- (5) C. wembacremsis Embedded in the mucilaginous mass of Gloeotrichia sp. in a puddle, Rankala side (1-3-53), (6-9-1953).

11. Genus Gloeotrichia Agardh

- (1) G. aethiopica W. and In a puddle (5-5-1954). G. S. West.
- (2) G. pilgeri Schemidle ... Ceratophyllum sp. in On puddle (8-1-1954).
- (3) G. pisum Thuret Epiphytic on water plants in a ex Bornet Flahault. puddle (8-1-1954).
- (4) G. raciborskii Wolosz-Common in pends, puddles paddy ynska. fields (Sep.-Feb.).

Family Scytonemataceae

12. Genus Tolypothrix

- (1) T. brevis (Gardner) On the bark of Cassia sp. Takala (10-6-1953).Geitler.
- (2) T. rechingeri (Wille) On the moist soil, Takala Geitler. (12-11-1953),

Habitat and Locality

13. Genus Scytonema

- (1) S. amplum W. et. G. S. On dripping rocks, (20-10-1953). West f. hibernica W. West.
- (2) S. bohneri Schmidle ... In a puddle, (5-9-1953).
- (3) S. ocellatum Lyngbye On water plants in a pond, ex Bornet et flahault. (6-9-1953).

14. Genus Petalonema Berkeley

(1) P. denusum (A. Br.) On moist soil, Takala (8-3-1953). Migula.

Family Nostocaceae

15. Genus Cylindrospermum

- (1) C. catenatum Ralfs ... As dirty black masses floating in a puddle, (12-12-53).
- (2) C. licheniforme Kuetz. In a small pond, (6-8-1953). ex. Bornet et Flah.
- (3) C. mainus Kuetz. ex On slopes, near a streamlet, Bornet et Flahault. Takala (31-8-1953); on moist soil near a pond, (6-9-53).
- (4) C. muscicola Kuetz. On moist soil, Takala (7-9-53). ex Bornet and Flahault v. longispora Dixit.
- C. sphaerica Prasad In a puddle, Kolhapur. f. cylindricum Kamat.
- (6) C. stagnale (Kuetzing) On moist soils, Takala (31-8-53, Bornet and Flahault. 6-9-1953).
- (7) C. trichotospermum In puddles, Rankala lake Fremy. (6-9-1953).

Family Nostocaceae

16. Genus Nostoc

- (1) N. commune Vaucher ex. Bornet & Flahault.
- (2) N. ellipsosporum (Desm.) On moist soils, Takala (6-9-53).

 Raben. On moist soil, old Rajaram College garden (7-10-1953).
- (3) N. microscopicum Carm. ex Bornet and Flahault.
- ex Bornet and Flahault. Takala (6-8-1953).

 (4) N. minutum Desm. ex On moist soil, Takala (25-9-53).
- Bornet and Flahault. (5) N. piscinale Kuetzing
- On soil on a stone wall, Takala (15-8-1953).

On moist soil on a stone wall,

(6) N. spongiae forme Agardh ex Bornet and Flahault,

ex Bornet & Flahault.

On moist soil, (16-9-1953).

17. Genus Anabaena Bory

(1) A. ambigua C. B. Rao Submerged in Rankala Lake (5-10-1953).

(2) A. fuellebornii Schmidle Floating in puddles, (6-9-53).

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Habitat and Locality

- (3) A. inaegualis (Kuetz.) In puddles, (8-1-54, 5-5-1954). Bornet and Flahault.
- (4) A. mediocris Gardner
- Floating in a puddle, (6-9-1953).
- (5) A.mysorensis Gonzalves and Kamat.
- Floating in a puddle, (5-9-1953).
- (6) A. orientalis Dixit In a puddle, (5-10-1953).
- (7) A. sphaerica Bornet Common in puddles (Januaryand Flahault. February).
- (8) A. volzii Lemmermann (6-9-1953).

Family Oscillatoraceae

- 18. Genus Arithrospira
 - (1) A. balkrishnanii Kamat In wells, Kolhapur (8-9-1954).
- 19. Genus Spirulina
 - (1) S. major Kuetzing ex Common in ponds, puddles Gomont. (October-May).
- 20. Genus Oscillatoria Vaucher
 - (1) O. acuta Bruehl and On moist soil near a streamlet at Biswas.
 - (2) O. amphibi Agardh ex In the mucilagenous mass Gomont. Gloeotrichia sp. floating in a pond, Kolhapur (8-9-53).
 - (3) O. amphigranulata Van Goor f. conia Kamat.
- On dripping, rocks, Kolhapur (19-7-1953).On

Takala (12-7-1953).

- (4) O. amoena (Kuetzing) Gomont of Kolhapurensis Kamat.
- moist soil. Kolhapur (8-1-1954).
- (5) O. amoena (Kuetzing) In a puddle, Takala, Kolhapur Gomont f. maharas- (9-10-1953). trensis Kamat.
 - In puddle, Kolhapur a (8-1-1954).
- (6) O. animales Agardh ex Gomont.

(7) O. annaevan Goor

- A form collected in the moist soil, Shahupuri.
- (8) O. annaevan Goor, f. Major Kamat.
- moist soil. Kolhapur (12-7-1953).
- (9) O. bharadwajae Kamat
- In a puddle, Takala, Kolhapur (5-5-1954).
- (10) O. biswasii Kamat

Major

- Floating in a puddle, Kolhapur (1-3-1954).
- (11) O. bourrellyi Kamat ... (12) O. brevis (Kuetzing)
- In a puddle, Kolhapur (8-8-53). On moist soil near a waste water passage, Kolhapur (23-3-54).
- Gomont v. non-granulata Kamat. (13) O. chalybea (Mertens)
- In a puddle, Kolhapur (8-8-53),
- Kamat. (14) O. corakiana Playfair v. non-granulata Kamat.

Gomont v.

On moist soil. Kolhapur (12-7-1953).

Habitat and Locality

- (15) O. cortiana Meneghini ex Gomont. v. miner Kamat.
- On moist soil, Takala, Kolhapur (20-7-1953).
- (16) O. decolorata G. S. In a drying puddle (21-3-1954). West.
- (17) O. formisa Bory exOn moist soil, Shahupuri (2-10-53). Gomont.
- (18) O. hamelii Fremy f. In a puddle, Kolhapur (8-3-1954). brevis Kamat.
 - 19) O. homogena Fremy On the bark of Cassia sp. (12-8-53) Floating in a puddle, or on the moist soil near a puddle, (20-8-1953).
- (20) O. limosa Agardh ex Gomont v. dispersogranulata Schkarb.
- On moist soil, Takala (19-7-53).
- (21) O. mitrae Kamat In a puddle, Kolhapur (2-10-53)
- (22) O. mougeotii (Kuetzing) Common on moist soild, in waste water passages, in puddles (September, November, January, February).
- (23) O. nigra Vaucher (24) O. okeni Agardh ex
 - In a puddle, Takala (12-7-53). Common on moist soils, paddy fields, puddles (June—August).
- (25) O. princeps Vaucher ex Gomont.

Gomont.

- On dripping rocks (19-7-53).
- (26) O. profunda Kirchner f. conica Kamat.
- In a streamlet, Kolhapur (20-10-1953).
- (27) O. prolifica (Grev.) In a puddle (2-10-53). Gomont.
- Schmidle. f. longa Kamat.
- (28) O. pseudogeminata G. In a puddle, Kolhapur (6-3-1954).
- (29) O.Bruehl and Biswas v. unigranulata R. N. Singh.
 - quadripunctulata In a puddle (8-2-1954).
- (30) O. rosea Utermohl ...
- In a puddle (8-3-1954).
- (31) O. rubescens D. C. ex Gomont.
- Common on moist soils (throughout the year). On leaves of Pistia sp. in a puddle (25-7-1953).
- (32) O. rubescems D. C. ex Gomont v. curvala Kamat.
- On moist soil, Takala, Kolhapur (28-2-1954).
- (33) O. rubescens D. C. ex Gomont v. Kolhapurensis Kamat.
- On dripping rocks, Kolhapur (10-8-1953).
- (34) O. schultzii Lemmercylindrica mann v. Kamat.
- In rain water pool, Kolhapur (12-7-1953).
- (35) O. Gomont.
 - simplicissima Floating in a pond (1-3-54).

Name

Habitat and Locality

- In a pool, Kolhapur (5-10-54). (36) O. suxenae Kamat
- (37) O. tambi Woronich Common on moist soils (July-September).
- Common on moist soils (July-(38) O. tenuis Agardh ex September). Gomont.
- In a rain water pool, Takala (19-7-53). In a puddle, (39) O. terebriformis Agardh ex Gomont. (8-2-1954).
- In a puddle, Kolhapur (9-10-53). (40) O. yamadae Kamat

21. Genus Phormidium Kuetzing

- (1) P. ambigum Gomont In a streamlet, or on moist soil near a streamlet, Takala (20-7-1953).
- In a streamlet, Takala (19-7-53) (2) P. anomala C. B. Rao ... on submerged soil Rankala lake side (6-8-1953).
- ... On the bark of Coconut tree, (3) P. belmeri Schridle Shahupuri (19-7-1953).
- Wille v. On moist soil, Kolhapur (28-7-53). (4) P. zylanicum minor Kamat.
- (5) P. corium (Agardh) On moist soil near a streamlet Takala (6-8-53), on the moist Gomont. soil Rankala side (8-9-53).
- On the bark of Cassia sp. Takala (6) P. molle (Kuetzing) (1-8-55), on moist soil Takala Gomont. (9-8-53). In a puddle Rankala side (8-1-1954).
- (7) P. musicola Huber-Pestabzziet Naumann.
- Along with *Microcystis* a puddle (19-7-1953).
- (8) P. papyraceum Gomont...
- On the bark of Coconut tree Shahupuri (12-7-1953).
- (9) P. pristleyi Fristsch
- On the bark of Coconut tree, Shahupuri.
- (10) P. stagina Rao, C. B. v. major Kamat.
- On the bark of Thespesia sp. Kolhapur (10-8-1953).
- (11) P. subincrustatum Fritsch and Rich
- On stones Rankala lake (19-7-53) The algae was not classified.
- (12) P. uncinatum (Ag.) Gomont.
- On the bark of *Pnhoenix* sp. Takala (16-7-1953).
- (13) P. viscosum Lemmer- ... mann.
- On the moist soil, Takala (29-8-53)

22. Genus Lyngbya

- (1) L. aerugineo-coerulea (Kuet.) Gomont.
- Common on trees. Slopes. moist soils (July-November).
- Goor
- (2) L. amphiyaginata Van. On dripping recks (19-7-1953).
- (3) L. antartica Gain v. In a puddle, Kolhapur (5-5-54). major Kamat.

Habital and Locality

- (4) L. attenuata F. E. On dripping rocks, Fritsch.
- (19-7-53)laboratory In a culture (26-7-1953).
- (5) L. brevissima (Kuetzing) Hansgirg.
- Epiphytic on filaments of the algae in a puddle, (5-5-1954)
- (6) L. digueti Gomont
- In a puddle, (8-1-54).
- (7) L. dixitii Kamat
- In a puddle, Kolhapur (10-10-53)
- (8) L. endophytica Elenkin and Hollerb.
- In the mucilaginous mass of Aphanothece sp. on dripping rock, (2-10-53).
- (9) L. fontana (Kuetzing) Hansgirg.
- On the bark of Ficus sp. Takala (6-8-1953).
- (10) L. gandhii Kamat
- Embedded in the mucilaginous mass of Aphanothece pallida on dripping rocks, Kolhapur (6-3-1954).
- (11) L. halophila Hansgirg
- dripping rocks, (19-7-53, On 2-10-1953).
- (12) L. kolhapurensis Kamat
- Epiphytic on Cladophora growing on snails in a pond, Kolhapur (5-5-1954).
- (13) L. lachneri (Zimmerman) Geitler.
- Epiphytic on other algae in a puddle, (20-7-1953, 8-1-54. 5-5-1954).
- (14) L. lachneri (Zimmerman) Geitler v. minor Kamat.
- Epiphytic on snails in a pond Kolhapur (5-5-1954).
- (15) L. mann.
- limnetica Lemmer- In a puddle, (5-5-54). सत्यमव जयत
- (16) L. Kamat.
 - maharastrensis In a puddle, Kolhapur (2-10-53).
- (17) L. majuscula Harvey In a puddle, (6-9-1953). ex Gomont.
- (18) L. martensiana Meneghini ex Gomont f.
 - On moist soil, Takala (16-7-53).
- rupestris Fremy. (19) L. molischi Vouk
 - In a puddle, (8-1-1954). . .
- (20) L. nigra Agardh ex Gomont.
- On moist soil, Takala (12-7-53).
- (21) L. nordyardhi Wille ...
- Epiphytic on *Rhizoclonium* sp.
- (22) L. perelegans Lemmermann.
- On dripping rocks, (19-7-53).
- (23) L.schmidlei Kamat (Lyngbya Kuetzingii Schmidle).
- Epiphyt on snails in a puddle, Kolhapur (5-5-1954).
- (24) L. semiplena Agardh ex Gomont.
- On the bark of *Phoenix* sp., Takala (16-7-1953).
- (25) L. shackletoni W. et G. S. West.
- In the mucilaginous mass of Aphanothece sp., (8-9-53).

125 ALGAE Name Habitat and Locality In the mucilagenous mass of (26) L. stagina Kuetzing Aphanotheca sp. on dripping non-granulata Kamat. rocks, Kolhapur (10-8-1953). On the moist soil near a streamlet, (27) L, truncicola Ghose ... Takala (12-7-1953). 23. Genus Hydrocoleum Kuetzing (1) H. subincrustaceus On moist soil, Takala (19-8-1953). Hansgirg. On moist soils, Takala (9-8-53, 24. Genus Microcoleus Desma-14-9-53, 28-2-1954). (1) M. amplus Gardner v. On the bark of Mangifera sp., Kolhapur. minor. Common on moist soils, on slopes (2) M. chthonoplastes Thurst ex Gomont. (July-October). Common. On moist soils along the road, near the ponds, dirty steenstrupli Boye (3) M. Petersen. water passages. (July—Oct.) Genus Symploca (1) S. muralis Kuetzing ex On dripping rocks, (2-9-53). Gomont. EUGLENOPHYCEAE OF KOLHAPUR 1. Genus Euglena (1) E. acus Ehrenberg ... In a puddle, (8-1-1954). (2) E. fusca (Klebs) Lemm In puddles, Takala (5-10-53,5-5-1954). In a dirty water pool, Takala, (3) E. heimii Lefeuse (5-10-1953). (4) E. maharastrensis In a pond, Kolhapur (6-3-1954). Kamat. (5) E. multiformis Schiller In a puddle, (5-5-1954). (6) E. oxyris Schmarda ... In a puddle, (6-3-54, 5-5-54). (7) E. rustica Schiller In a pond, (6-3-1954).

In

dirty

In a puddle, (8-1-1954).

In a puddle, (1-3-1954).

In a puddle, (5-5-1954).

In a puddle, (1-10-1953).

In a puddle, (6-3-1954).

November).

Common in puddle (October-

(20-10-1953).

water

pool,

(8) E. sacculiformis Schiller

(1) L. ovum (Ehrenberg)

salina Fritsch v.

ahmedabadensis Kamat

(9) E. tuberculata Swir

Lammermann.

(1) P. acuminatus Stokes

(2) P. caudatus Huebner ...

(3) P. curvicay 2 Swirenke

2. Genus Lepocinclis Perty.

3. Genus Phacus Dujardin

(2) L.

25.

Habitat and Locality

- (4) P. hameli Allorge and In a dirty water pool, Takala Lefevre. (5-10-1953).
- (5) P. horridus Pochmann In a dirty water pool, Takala (5-10-1953).
- (6) P. longicauda (E). In a puddle (5-10-1953) (5-5-1954) Dujardin.
- (7) P. onyx Pochmann .. In a pool (21-3-1954).
- (8) P. pleuronects (O. F. M.) In a dirty water puddle, Shahupuri Dujardin. (8-1-1954).
- (9) P. suecicus Lemmer- In a dirty water pool, Takala mann. (5-10-1953).
- (10) P. tortus (Lemm.) In a dirty water pool, Takala Skvertzov. (5-10-1953).
- (11) P. ungus Pochmann .. In a shaded pool, Takala (1-3-54). In a puddle (5-5-1954).

4. Genus Trachelomonas

- (1) T. armata Stein v. steinii In a puddle (2-10-1953, 5-5-1954). Lemm. emend Deff.
- (2) T. desikacharyi Kamat In a puddle, Kolhapur (6-10-1953).
- (3) T. cordata (Drez.). In a puddle (5-5-1954). Comb. Deflandre f. minor Deflandre.
- (4) T. hispida (Perty) Stein In a puddle, Takala (8-2-1954.) emend. Deflandre.
- (5) T. hispida (Perty) Stein In a puddle, Takala. emend; Deflandre f. minor Bourr.
- (6) T. oblonga Lemm. ... In a puddle, Shahupuri (5-10-1953)
- (7) T. ovalis Daday v. In a puddle (7-10-1953).

 maharashtrensis Kamat
- (8) T. phulcherrima Playfair In a puddle (7-10-1953).
- (9) T. superba Swiremend In a dirty water pool (8-1-54). Deflandre. (5-10-1953).
- (10) T. sydneyensis Playfair In a dirty water pool, Takala.
- (11) T. volvocina Ehrenberg Common, in a dirty water ponds and puddle, Takala (Jan. 1954).

5. Genus Strombomonas Deflandre

S. urceolata (Stokes) In a puddle, Kolhapur (6-3-1954).
Deflandre v. kolhapur ensis Kamat.

Family Astasiaceae

6. Genus Astasia Ehrendberg

- (1) A. ovalis Huber-pestal- In a puddle (1-3-1954). ozzi.
- 7. Genus Menoidium Perty
 - (1) M. cultellus E. G. Prinsheim.
- In a puddle, Rankala side (1-3-1954).

CHLOROPHYCEAE OF KOLHAPUR

Family Palmellaceae

Names

Habitat and Locality

- 1. Genus Gloeocystis
 - (1) G. ampla (Kuetz) Lager- In a small pond (5-5-1954). heim.
 - (2) G. gigas (Kuetz) Lager- In a puddles, small ponds, Takala heim. (January-April).

Family Ulotrichaceae

2. Jenus Ulothrix

Ulotlarix aegualis Kuetz .. In a streamlet Takala (20-7-53), Rankala lake side in small water reservoir (20-10-1953).

Family Cylindrocapsaceae

3. Genus Cylindrocapsa

C. geminella Wolle

.. In a puddle, Rankala side (5-10-53).

Family Chaetophoraceae

4. Genus Stigeoclonium

S. labricum (Dilnoyn) Kuetz Takala (16-7-53). In a puddle (2-9-1953).

5. Genus Chaetophora

C. elegans (Roth) C. A. In a puddle. Agardh.

Family Protococcaceae

6. Genus Protococcus

P. viridis Agardh.

Family Coleochaetaceae

- 7. Genus Coleochacte
 - (1) C. irregularis Pring- In a puddle, Rankala lake. sheim.

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- (2) C. orbicularis Pringsheim.
- (3) C. scutata De Brebisson

Family Ulvaceae

- 8. Genus Enteromorpha
 - 1. E. proligera (Fl. Dan.) In a puddle, Rankala lake side Agardh.

Family Cloophoraceae

- 9. Genus Clodophora Callicoma Kuetzing.
- 10. Genus Pithophora
 - P. oedogonia (Mont.) Witt- In puddles, ponds.

BOTANY AND FLORA Habitat and Locality Name Genus Rhizoclonium hieroglyphicum (C. A. In puddles, ponds. Agardh), Kuetz Family Oedogoniaceae Genus Oedocladium 12. On moist soil. Oedocladium sp Genus Bulbochaete 13. Takala (8-8-1953). B. brevifulta Wittrock ex In a puddle, Hirn 14. Genus Oedogonium Epiphytic on leaves of water (1) O. abbreviatum (Hirn) plants in a small pond, Takala Tiffany v. maius Kamat (6-9-1953). In a pond, (5-9-1953). (2) O. capillare (L.) Kuetz. ex Hirn Free floating or adhering (3) O. capilliforme Kuetz. Wittrock ex Hirn. v. water plants in a rain water pool nanum Randhwa Takala. Rankala lake. (4) O. consociatum Collins and Hirvey v. Kolhapurense Kamat In a rain water pool, Takala (5) O. costatosporum Jao (12-7-1953).In a puddle, Takala (1-3-1954). (6) O. epiphyticum Transeu and Tiffany Geminhandl (7) O. edogonium formosum In a puddle, Kolhapur (8-2-1954). Kamat Kolhapur lake, (8) O. gelatinosum Kamat Rankala (5-10-1953). In a pool, Kolhapur. (9) O. geminatum Kamat (30-8-53) (7-10-53). In wadis Hallas f. (10) O. glabrum maharashtrense f. Kolhapur. In a small pond, Kolhapur (11) O. hatei sp. nov. (8-2-1954).In a pond, Kolhapur (6-9-53). (12) O. hindustonense Kamat In a pond, Kolhapur (8-9-1953).

(13) O. imahorii Kamat

(14) O. intermedium Wittrock ex Hirn.

(15) O. kirtikarii Kamat ...

(16) O. kolhapurense Kamat

(17) O.lammermannii Tiffany

(18) O. longipilum Jao

(19) O. maharachtrense Kamat

Takala (12-7-1953). Rankala lake, Kolhapur (5-10-1953).

In ponds, puddles, streamlets

(July-August); on moist soil,

In a pool, Takala (5-10-53).

In a pool, Takala (5-10-1953).

Epiphyte on Chara sp. in Rankala lake (5-10-53). Floating in a puddle, Rankala side.

In a puddle, Kolhapur (8-1-54).

129 ALGAB Habitat and Locality Name In a puddle, Rankala side (8-1-54). (20) O. minus Wittrock ex Hirn (21) O. nankingense Jao Floating in 8. small pond, (8-2-1954),In a pool, Kolhapur (8-1-1954). (22) O. oyei Kamat (23) O. paucostriatum Common in ponds, puddles, Takala (August-September). Tiffany In a puddle, (8-1-1954). (24) O. plagiostomum Wittrock ex Hirn (25) O. prescotti Kamat In a puddle, Kolhapur (8-8-53). In a puddle, Kolhapur. (26) O. princeps (Hassall) Wittrock ex Hirn In a puddle, Kolhapur. pringsheimii (Cra-(27) O. mer); Wittrock ex Hirn pseudospirala Ny-In puddles, ponds, Rankala (28) O. side (August, September 1953, gaard January 1954). In a streamlet, Kolhapur(8-8-53). (29) O. repens Kamat (30) O. robustrum Tiffany In a small pond, (6-9-1953). (31) O. rugulosum Nordstedt Common in ponds, Rankala side (January-April). ex Hirn Epiphyte on Chara sp. in Rankala (32) O. santapaui Kamat ... lake (5-10-1953). In a pond, (5-5-1954). (33) O. santurnse Tiffany ... In a puddle, Kolhapur (5-10-53). (34) O. singhii Kamat In a pond, (5-9-1953). (35) O.spirale Hira · v. maius Singh (36) O. stephensiae Tiffany In a puddle, (8-1-54), (5-5-1954). In a puddle, (8-1-1954). (37) O. tapeinosporum Wittrock ex Hirn (Bre- In a small pond, (5-9-1953). undulatum (38) O.

- (38) O. undulatum (Bre- In a smal bisson) A. Braun;
 Wittrock ex Hirn
- (39) O. unisporum sp. nov. In a puddle, Kolhapur (6-9-1953).
- (40) O. vaucherii (Le Clarc) In puddle, Kolhapur (6-9-1953)

 A. Braun, Wittrock ex
 Hirn

Family Chlorococcaceae

15. Genus Characium

(1) C. rostratum Reinhard In a puddle, Rankala side (5-10-53) ex Printz.

16. Genus Characlosiphon

(1) C. rivularis Iyengar .. Takala (August-September).

Family Hydrodictaceae

17. Genus Hydrodictyon

(1) H. reticulatum (L.) Lager- Common in puddles, (July-heim September).

Habitat and Locality

18. Genus Pediastrum

- (1) P. clathratum (Schroeter) In a pond, (5-5-1954). Lemmermann
- (2) P. deplex Meyen v. In a puddle, (5-5-1954).
 clathratum (A. Braun)
 Lagerheim
- (3) P. muticum Kuetzing v. In a pond, (6-9-1953). crenulatum (Prescott).
- (4) P. ovatum (Ehrbg.) A. In a puddle (8-1-1954). Braun
- (5) P. simplex (Meyen) In a small pond, Rankala side Lemmermann v. duodenarium (Bailey)
 Rabenh.
- (6) P. tetras (Ehrenberg) Common, in puddles small ponds, Ralfs. Rankala lake side.

19. Genus Sorastrum

S. spinulosum Naegeli ... In puddles, Rankala lake side (5-9-53, 16-10-1953).

Family Coelastraceae

20. Genus Coelastrum

C. microsporum Naegeli ... Common in pools, puddles, ponds (August-October, March-May 1954).

Family Oocystadeae

21. Genus Ankistrodesmus

- (1) A. falcatus (Corda) Common in puddles (September-Ralfs October 1953).
- (2) A. fractus (West and In a pond, (6-9-1953). West) Brunn.
- (3) A. spiralis (Turner) Lemmermann

22. Genus Dimorphococcus

D. lunatus A. Braun. In pools, puddle, Takala, Rankala side (5-10-53), (1-3-1954).

23. Genus Gloeotaenium

G. loitelsbergeanum In puddles, ponds. Hansgirg.

24. Genus Kirchneriella

K. lunaris (Kirchner) In pools, puddles, Rankala side Moebius (5-10-53, 17-3-1954).

25. Genus Oocystis

- (1) O. borgi Snow .. In a pond, (6-9-1953).
- (2) O. elliptica W. West .. In a pool, (6-9-1953).
- (3) O. gigas Archer ... In a puddle, Rankala side (5-10-1953).

Habitat and Locality

- (4) O. Kolhapurensis Kamat In puddles, Kolhapur (5-10-53).
- (5) O. maharashtrensis Kamat

In puddles, Kolhapur (5-10-1953).

26. Genus Tetraedron

- In a puddle, (5-5-1954). (1) T. muticum (A. Braun) Hansgirg
- In a puddle, (5-5-1954). (2) T. muticum (A. Braun) Hansgirg f. punctulatum (Reinsch) De Toni
- (3) T. trigonum (Naegeli) Hansgirg v. tetragonum (Naegeli) Rabenh.

In a puddle (5-5-1954).

27. Genus Trachisca Kuetzing

1. T. granulata (Reinsch) In puddles, (8-1-54, 5-5-54). Hansgirg

Family Scenedesmaceae

- 28. Genus Scenedesmus

- (1) S. abundans (Kirchner) In a puddle, (5-5-1954). Chotat v. brevicauda
- (2) S. abundans (Kirchner) In a pond, Kolhapur (2-10-1953). Chotat v. indica Kamat
- spicatus (West and West) Smith.
- (3) S. abundans Chotat v. In a pool, Rankala side (2-10-53).
- (4) S. arculatus Lemmer- In a pond, Takala (20-10-1953).
- (5) S. arculatus Lemmer- In a puddle, Rankala side ponds (5-10-53, 5-5-1954). v. platydisca
- Smith (6) S. bicaudatus (Hansg.) Chotat.

mann

- Common in puddles, (October 1953, January-May 1954).
- (7) S. bujuga (Turp) Lagerheim v. irregularis (wille) Smith
- Common in puddles (November-May) (6-3-1954).
- (8) S. brasiliensis Bohlin ...
- (9) S. denticulatis Lagerheim v. Kolhapurensis Kamat
- In a puddle, Takala, Rankala. In a pond, Kolhapur (8-8-1953).
- (10) S. dimorphus (Turp.) Kuetzing
- Common in puddles, ponds (Oct.-November. 1953, February-May 1954).
- (11) S. faldatus Chota v. major Kamat
- In a pond Kolhapur (6-5-1954). In a puddle, Kolhapur (8-1-1954).
- (12) S. kolhapurensis Kamat (13) S. longus Meyen v.
- In laboratory cultures, from a streamlet, Takala (8-8-1953).
- brevispina Smith. (14) S. longus Meyen v. dispat (De Breb.) Smith
- In a puddle (2-9-1953).

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- (15) S. maharashtrensis Kamat
- In Vadis, Kolhapur (7-2-1954)
- (16) S. margalefii Kamat ...
- In puddles, Kolhapur (12-10-53).
- (17) S. obliqus (Turp.)Kuet-
- In a pond, Takala, Rankala lake. (2-9-53, 5-10-53, 5-5-1954).
- (18) S. opoliensis Richter ...
- In a pond, Takala, Rankala.
- (19) S. quadricauda (Turp.) De Breb. v. longispina (Chotat) Smith.
- In a puddle, (5-5-1954).
- (20) S. quadricauda (Turp.)
 De Breb. v. maximum
 West and West
- In a pond, (5-5-1954).
- (21) S. quadricauda (Turp). De Breb. v. westii Smith

In puddles by Rankala side.

Family Mesotaeniaceae

- 29. Genus Cylinadrocystis
 - (1) C. minutissima Turner On dripping rocks, Kolhapur v. kolhapurensis Kamat (9-1-1954).
- 30. Genus Mesotaenium Naegeli
 - (1) M. macrococcum . On dripping rocks, Takala (Kuetz.) Roy and (9-8-53).

 Bissett v. micrococcum (Kuetz.)
 West and West
 - (2) M. micrificum Arch. On dripping rocks, Takala West and West (9-7-53).

Family Desmidiaceae

- 31. Genus Closterium Nitzsch
 - (1) C. ehrenbergii Mene- In a puddle ghini f. attenuatum Kamat
 - In a puddle, Kolhapur (21-8-53).
 - (2) C. dianae Ehrenberg . .
- In puddle, (2-10-53).
- (3) C. kolhapurense Kamat In a pool, Kolhapur (5-10-53).
 - In a pool, Kolhapur (5-10-53). In a pool, Kolhapur (5-10-53).
- (4) C. kolhapurense Kamat v. minus var. nov. Kamat
 - in a poor, Romapur (5-10-55).
- (5) C. lanceolatum Kuetzing West and West
- Common in puddles, water reservoirs (Sept.).
- (6) C. maharastrense . Kamat
- In a puddle, Kolhapur (8-2-54).

puddles

- (7) C. moniliferum (Bory) Ehrenberg West and West
- (September-October).
- (8) C. parvulum Naeg. West and West
- In a small puddle, (5-5-54).

Common in pools,

- (9) C. rectimarginatum . . Scott and Prescott v. majus Kamat
- In a small pond, Kolhapur (8-1-54).
 In a puddle, Parva, Kolhapur (8-1-54).

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West

Common in pools, puddles (10) C. venus Kuetzing West (September-October). and West Genus Pleurotaenium Naegeli 32. (1) P. eugeneum (Turner) In the mucilage of Nitella sp. in a puddle, Takala (5-10-53). West and Prescott. In a puddle, (6-9-53). (2) P. trabecula (Ehrenberg) Naegeli f. clavata (Kuetzing) West and West Common in a pool (Jan-March) (3) P. trabecula (Ehrenberg) Naegeli v. elongatum Cedergren (4) P. trabecula (Ehrenberg) In Rankala lake (5-10-53). Naeg. v. rectum (Delp.) West and West 33. Genus Cosmarium Corda (1) C. amoenum Brebisson On dripping rocks, (9-8-53). West and West In a puddle, Takala (6-9-53). cucumis (2) Cosmarium Brebisson v. attenuatum G. S. West. puddles, ponds. (3) C. dentiferum Corda Common in v. minus Kamat (September-October)January 54. Embedded in the mucilaginous (4) C. granatum Brebisson Irenee-Marie mass of Aphanothece sp. on dripping rock. (9-8-53). In a puddle, Takala (6-9-53). Reinsch In a shaded puddle, (March 1953). (5) C. hammeri West and West pools, puddles Elfv. Common in (6) C. impresulum (January-May). West and West Rabenhorst On moist soil, Shahupuri (12-8-53), (7) C. laeve In a small puddle, (8-1-54). West and West (8) C. lundellii Delp. West In a puddle, (5-9-53). and West On dripping rocks, Kolhapur. (9) C. maharastrense (21-8-53).Kamat In a puddle, Rankala lake side (10) C. obtusatum Schmidle (28-2-54).Embedded in the mucilaginous (11) C. pachydermum Lund mass of Glocotrichia sp. floating v. aethiopicum West in a pond, (5-9-53). and West Rare. In Rankala lake (8-1-54). (12) C. subcucumis Schmidle (13) C. subimpressulum ... in puddles, ponds Common (January-April). Borge a water reservoir, Takala (14) C. subprotumidum (12-7-53).Nordstedt West and

Habitat and Locality

- (15) C. subretusiforme West and G. S. West v. majus Kamat
- (15) C. subretusiforme West In a pond, Kolhapur (8-1-54).
- (16) C. subtumidum Nordstedt f.minor Krieger
- In a pool, (5-10-53). In a pond, Takala (8-5-54).
- (17) C. tumens Nordstedt ...
- In a pond, Takala (5-10-53). On moist soil of a drying puddle, (6-3-54).
- (18) C. undulatum Corda ...
- On moist soil, old Rajaram College garden (28-2-54).
- (19) C. undulatum Corda v. minutum Wittrock
- In the squeezings of the leaves of water plants, (6-9-53). In a pool, (2-10-53).
- (20) C. undulatum Corda v. wollei West
- On moist soil near a streamlet, Takala (12-7-53).
- (21) C. venustum (Breb.)
 Arch. f. minor Wolle.
- In a drying pond, (5-5-54).
- (22) C. vexatum West
- Common in puddles, ponds, streamlets (September-October).

34. Genus Euastrum Ehrenberg

- (1) E. binale (Turp.)
 Ehrenberg
- In the squeezings of the water plants in a pond, (6-9-53).
- (2) E. binale (Turp.) Ehrenberg
- On moist soil near a streamlet (6-9-53).
- (3) E. spinulosum Delp. ...
- Common in puddles, ponds (October 1953, March 1954).

35. Genus Staurastrum Meyen

- (1) S. gamelliparum .. In Nordstedt.
- In a puddle, Takala (8-8-53).
- (2) S. gracile Ralfs v. nannum Wolle, West and Carter
 - Ralfs v. In a puddle, Rankala side /olle, West (5-10-53).
- (3) S. punctulatum Brebisson.
- In a puddle, (27-5-54).
- (4) S. punctulatum
 Brebisson v. ellipticum Lewin forma
 Krieger
- In a drying pond, (5-5-54).

36. Genus Hyalotheca Ehrenberg

- H. dissiliens (Sm.) Brebisson v. hians Wolle
- Adhering to the roots of aquatic plants in a pond, (8-8-53).
- 37. Genus Desmidium C. A. Agardh
 - D. aptogonum Brebisson
 v. ehrenbergii
 Kuetzing
- Common in puddles, ponds (August-September 1953, January 54).

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Name

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Family Zygnemataceae

- 38. Genus Mougeotia (Agardh) Wittrock.
 - (1) M. floridana Transcau In a puddle, (5-9-53).
 - (2) M. poinciana Transeau In a puddle, Kolhapur (26-8-53). v. minor Kamat In Vadis, Kolhapur (26-8-53).

39. Genus Spirogyra

- (1) S. africana (Fritsch) In a puddle, Tak'ala, Kolhapur Czurda f. major (30-8-53). Kamat In Vadis, Takala, Kolhapur, (30-8-53).
- (2) S. azygospora Singh v. Floating in a puddle, (6-9-53). inflata Kamat
- (3) S. chakiaense (Rao) In Rankala lake (5-10-53). Krieger
- (4) S. communis (Hassall) In a pond, (5-5-54). Kuetzing
- (5) S. daedalea Lagerheim In a pool, (30-8-53). In a pond, Takala (5-5-54).
- (6) S. dubia Kuetzing ... In a puddle, (8-1-54).
- (7) S. fuellebornei Schmidle In a puddle, (5-5-54).
- (8) S. hautillensis Tran- In a pond, Kolhapur seau v. Kolhapuren- (25-12-53). In a lake, Kolhapur sis v. nov. (25-12-53).
- (9) S. hyalina Cleve ... In a puddle, (5-5-54).
- (10) S. indica Krieger ... In a puddle (8-1-54).
- (11) S. kolhapurensis sp. nov. In a puddle, Kolhapur (8-8-53) In Vadis, Kolhapur (8-8-53).
- (12) S. liana Transeau ... In a puddle, Rankala side (8-1-54).
- (13) S. longata Krieger ... Floating in a pond, Rankala side (6-9-53).
- (14) S. majuscula Kuetzing In a puddle, Takala, Kolhapur v. inflata v. nov. (1-3-54). In Vadis, Takala, Kolhapur (1-3-54).
- (15) S. maxima (Hassall) Floating in a puddle, (5-9-53; Wittrock. 8-1-54).
- (16) S. neglecta (Hassall) In a puddle, (20-10-53). Kuetz.
- (17) S. nitida (Dillwyn) Common in puddles, ponds Link (September-October).
- (18) S. setiformis (Roth) In puddles, Takala (5-9-53). Kuetz.
- (19) S. singularis Nordstedt In a puddle, Kolhapur (8-1-54).

 v. major v. nov. In Vadis, Kolhapur (8-1-54).
- (20) S. speciana Rabehorst In a streamlet, Takala (20-9-53). In a puddle, (8-1-54).
- (21) S. submaxima Transeau Common in puddles, ponds, (September-October 1953; January-March 1954).

BOTANY AND FLORA Name Habitat and Locality Genus Sirocladium Randhawa 40. (1) S. kumaoense On moist soil, Rajaram College Randhawa. garden (29-9-53). Genus Zygnema C. A. Agardh 41. (1) Zygnema insigne In a puddle, (8-8-53). (Hassall) Kuetz. (2) Z. kolhapurense Kamat In a puddle, Takala, Kolhapur (8-8-53). In *Vadis*, Takala Kolhapur (8-8-53). (3) **Z.** maharashtrense In a puddle, Kolhapur (8-8-53). Kamat. In Vadis, Kolhapur (8-8-53). (4) Z. momoniense W. Common in puddles, ponds West. (September-October 1953); (January 1954). (5) Z. sterile Transeau In a puddle, (August-September 1953). CHAROPHYTA OF KOLHAPUR Family Characeae 1. Genus Nitella A. Braun (1) N. acuminata A Braun In a pond, Takala (5-10-53). In a puddle Rankala side (8-1-54). (2) N. batrachosperma In a puddle, Rankala (5-10-53). (Reichenback) (8-1-54). A. Braun. (3) N. furcata (Roxburgh Common in puddles (Septemberapud (Burzelius) October). Agardh. In a puddle, (4) N. leptodactyla

Genus Chara Vallient

J. Groves.

(1) C. brachypus In puddles, Takala (September). A. Braun.

(8-1-54).

Rankala

side

- (2) C. globularis Thiller ... In a drying pond, (6-3-54).
- (3) C. vulgarks Linnaeus Common in puddles, ponds (October-November 1953).

16. ALGAE OF PANHALA

(After N. D. Kamat)

CYANOPHYCEAE

Family Chroococcaceae

- 1. Genus Aphanocapsa.
 - (1) A. biformis A. Hr.
 - (2) A. fusolujtea Hansgirg.
 - (3) A. grevillei (Hass.) Rabenhorst.
 - (4) A. muscicola (Meneghini) Wolle.

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- (5) A. roseana de Bary.
- (6) A. costagnei (Breb.) Rabenhorst.
- (7) A. pallida (Kuetzing) Rabenhorst.
- 2. Genus Chroococcus
 - (1) C. montanus Hansgirg.
 - (2) C. turicensis (Naegeli) Hansgirg.

Family Rivulariaceae

3. Genus Gloeotrichia

G. raciborskii Woloszynska.

4. Genus Rivularia.

R. maharashtrensis Kamat.

Family Microchaetaceae

5. Genus Microchaete

M. tenera

Thuret ex Born. et Flab.

Family Scytonemaceae

- 6. Genus Tolypothrix.
 - T. robusta Gardner.
- 7. Genus Scytonema
 - (1) S. lyngbyoides Gardner.
 - (2) S. stuposum (Kuetzing). Born. at Flah.

Family Nostocaecae

- 8. Genus Cylindrospermum
 - (1) C. stagnale (Kuetzing) Bornet Flah.
 - (2) C. stagnate (Kuetz) Born. et Flah v. minus Kamat.
- 9. Genus Nostoc
 - (1) N. commune Voucher ex Born. et Flah.
 - (2) N. microscopicum Carm. ex Born. et Flah.
 - (3) N. piscinale Kuetzing ex Born. et Flah.
- 10. Genus Nodularia
 - N. harveyana Thuret.

Family Oscillatoriaceae

- 11. Genus Oscillatoria
 - (1) O. brevis (Kuetz.) Gomont.
 - (2) O. granulata Gardner v. major Kamat.
 - (3) O. maharastrensis Kamat.
 - (4) O. pseudogeminata G. Schmid.
 - (5) O. terebriformis Agardh ex Gomont.

Habitat and Locality

17. ALGAE OF MAHABALESHWAR

EUGLENOPHYTAA

- 1. Genus Trachelomonas Ehren.
 - T. hispida (Perty) Stein Floating along with other alga cmend. Deflandre in Venna lake.
 v. duplex Deflandre.

CYANOPHYCEAE

Family Chroococcaceae

- 1. Genus Aphanocapsa Naegeli
 - (1) A. musicola (Meneghini) On dripping rocks. Wille.
 - (2) A. bullora (Meneghini) On dripping rocks.
 Rabenherst.
 - (3) A. castegnei (Brebisson) On dripping rocks. Rabenherst.
 - (4) A. pallida (Kuetz.) In a pond. Rabenherst.
- 2. Genus Chroococcus Naegeli
 - (1) C. minutes (Kuetzing) On dripping rocks cells solitary Naegeli. or in twos.
 - (2) C. turicensis (Naegeli) On dripping rocks. Hansgirg.
- 3. Genus Gloeothece Naegeli
 - (1) G. palea (Kuetz.) On dripping rocks.
 - (2) G. rupestris (Lyngbye) On dripping rocks.
 Bornet.

Family Nostochopsidaceae.

- 4. Genus Nostochopsis
 - N. lobatus Wood emend. On dripping rocks. Geitler.

Family Microchaetaceae

- 5. Genus Aulosira Kirchner
 - (1) A. impexa Born. et On dripping rocks. Flah, v. crassa Dixit.
- 6. Genus Fortiea De Toni
 - (1) F. bossei (Fremy) On dripping water. Desikachary v. indica Kamat.

Family Rivulariaceae

- 7. Genus Calothrix Agardh.

 C. fusca (Kuetz.) Born, et Embedded in Nostoc colonies.

 Flah.
- 8. Genus Dichothrix
 - (1) D. baueriana (Grun.) In dripping water. Born. et Flah.

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9. Genus Rivularia (Roth) Agardh.

R. dura Roth ex Born.. On dripping rocks. et Flah.

Family Scytonemataceae

- 10. Genus Tolypothrix Kuetzing
 - (1) T. byssoidea (Hassell) On dripping rocks. Kirchner.
 - (2) T. rupestris Wolle ... On dripping rocks.
- 11. Genus Scytonema Agardh'
 - (1) S. myochrous (Dilw.) On dripping rocks. Agardh.

Family Nostocaceae

- 12. Genus Anabaena Bory
 - A. torulesa (Carm). .. On dripping rocks.
- 13. Genus Cylindrospermum Kuetzing
 - (1) C. muscicola Kuetz, ex On dripping rocks. Born, et Flah.
 - (2) C. stagnale (Kuetz.) Born et Flah.
- 14. Genus Nostoc Vaucher
 - N. commune Vaucher On dripping rocks. ex Born, et Flah.
 - (2) N. microscopicum Carm. On dripping rocks. ex Born, et Flah.
 - (3) N. muscorum Agardh On dripping rocks. ex Born, et Flah.
 - (4) N. piscinale Kuetzing On dripping rocks. ex Born, et Flah.

Family Oscillatoriaceae

- 15. Genus Oscillaloria Vaucher
 - (1) O. crosdalei Kamat .. In a pond (15-10-1957).
 - (2) O. jasorvensis Vouk .. On dripping rocks.
 - (3) O. mahabaleshwarensis On dripping rocks. Kamat.
- Genus Phormidum Kuetzing
 P. rividum Naegeli
- 17. Genus Lyngbya Agardh
 - (1) L. allorgei Fermy v. granulata Kamat.
 - (2) L. lutea (Agardh) On moist soil along with.
 Gomont.
- 18. Genus Schizothrix Kuetzing
 S. fragilis (Kuetz.) Gomont

Habitat and Locality

CHLOROPHYTA

Family Tetrasporaceae

1. Genus Tetraspora Link

T. gelatinosa (Vaucher) .. In Dina lake. Desvaux.

Family Cladophoraceae

2. Genus Cladophora Kuetzing

C. callicoma Kuetz. . . On stones in a pond.

3. Genus Rhizoclonium

Kuetzing.

R. hieroglyphicum (Agardh) Kuetzing.

Floating at the shores in Venna lake (Mahabaleshwar).

Family Coelastraceae

4. Genus Coelastrum Naegeli

C. microsporum Naegeli .. Floating along with other algae in Venna lake.

5. Genus Pediastrum

P. tetras (Ehren.) Ralís. .. Floating along with other algae in Venna lake.

Family Oocystaceae

6. Genus Ankistrodesmus

A. falcatus (Corda) Floating along with other algae in Venna lake.

Family Scenedesmaceae

7. Genus Scenedesmus

S. mahableshwarensis Kamat In a pond, Mahabaleshwar (16-10-57).

Family Zygnemataceae

8. Genus Zygnema Zygnema extenue Jao

Floating in Venna lake.

9. Genus Spirogyra

S. fossa Jao

.. Floating in Venna lake.

S. mirabilis (Hassall) In

(Hassall) In Venna lake (16-10-57).

Kuetz. maharashtrensis Kamat

Family Mesotaeniaceae

10. Genus Mesotaenium

M. mirificum Arch. v. In humid axes of trees (17-10-57).

mahabaleshwarensis

Kamat.

Family Desmidiaceae

11. Genus Closterium

C. macilentum Brebisson In a discarded well along the Babington point.

Habitat and Locality

C. undulatum Corda On dripping rocks.
v. crenulatum (Naegeli)
Wittrock.

G. undulatum Corda v. Floating along with other algae wollei West. in Venna lake.

12. Genus Micrasterias

M. denticulata Brebission Floating along with other algae in Venna lake.

13. Genus Staurastrum

1. S. setigerum Cleve .. Floating with other algae in Venna lake.

14. Genus Hyalotheca

H. burmensis W. and G. S. Floating with other algae in West.

H. mucosa (Mert.) .. Floating along with other algae Ehrenberg. in Venna lake.

15. Genus Spondylosium S. lundellii Borge. . .

Floating along with other algae in Venna lake.

18. ALGAE OF MARATHWADA

We shall now consider the Algae of Marathwada region. There is only one paper dealing with them by N. D. Kamat (1974) in *Phykos* 3 (1): 22—32. It gives account of 151 Algae collected at Aurangabad, Parli, Beed, Jalna, Osmanabad, Parbhani and Nanded. The species belong to Chlorophyceae, Euglenophyceae, Dinophyceae, Xanthophyceae and Cyanophyceae. Of these 65 species belong to Chlorophyceae, 27 belong to Euglenophyceae, 3 to Dinophyceae, 1 to Xanthophyceae and 54 to Cyanophyceae.

The region is full of a number of ponds and seasonal water streams running zig-zag. They contain many algae. The largest number is constituted by species of Spirogyra, Zygnema, Mouqueotia, Oedogonium Bulbochaete, Nostoc, Cylindrospermum and Anaebaena. Since all the habitats have not been checked, it is likely that many more species and forms would be found. So far the richest growth of Algae was noted in a pond at Osmanabad.

CHLOROPHYTA

Name

Habitat and Locality

1 Pandorina morum (Muell.) Mundlika stream, Jalna, Bory. Pond, Osmanabad.

 Gloeocystis vesiculosa ... Pond, Osmanabad. Naegeli.

3 Tetraspora lubrica (Roth) . . Bindusara dam, Parli. Agardh. Puddle, Aurangabad.

Habitat and Locality

4	Pediastrum duplex Meyen v. reticulatum Lagarh	Hansool lake, Parbhani. Pools, Aurangabad. Pools, Nanded. Pools, Beed.
5	P. duplex Meyen v. subgranulatum Racib.	Ponds, Osmanabad. Streamlet, Aurangabad.
6	P. simplex Meyen	Moti Talao, Jalna. Streamlet, Aurangabad. Ponds, Nanded.
7	P. simplex Meyen V. duode- narium (Baily) Rabenh.	Harsool lake, Aurangabad. Moti Talao, Jalna.
8	P. tetras (Ehr.) Ralfs v. tetradon (Corda) Rabenh.	Ponds, Osmanabad. Puddle, Parbhani. Ponds, Nanded. Pools, Aurangabad.
9	Sorastrum americanum (Bohlin) Schmidle.	Ponds, Osmanabad.
10	Coelastrum microporum Naegeli.	Kundalika stream, Jalna. Harsool lake, Aurangabad. Puddles, Nanded.
11	C. scabrum Roinsch	Harsool lake, Aurangabad. Bindusara dam, Pali.
12	Dictyosphaerium pulchellum Wool.	Harsool lake, Aurangabad.
13	Oocystis gigas Archer	Ponds, Osmanabad.
14	O. macrospora (Turp.) Brunnthaler.	Puddles, Aurangabad.
15	O. lacustris Chodat	Stream, Beed.
16	O. naegelii A. Br	Ponds, Osmanabad.
	O. nacgem A. Bi.	Pools, Parbhani. Pools, Beed.
17	O. solitaria Wittrock	Moti Talao, Jalna. Ponds, Osmanabad. Pools, Aurangabad.
18	Nephrocytium agardhianum Naeg.	Moti Talao, Jalna. Ponds, Nanded. Bhogavati stream, Osmanabad.
19	Chodatella subsalsa Lamm	Harsool lake, Aurangabad.
20	Ankistrodesmus falcatus (Corda) Ralfs.	Ponds, Osmanabad. Stream, Jalna. Cistern, Aurangabad.
21	A. sigmoides (Rabenh.) Bruhl. et Biswas.	0. 7.1
22	Schroederia indica Phillipose	Ponds, Osmanabad.
23	Selenastrum gracile Reinsch	Ponds, Osmanabad.
24	Tetraedron incus (Teiling) G. M. Smith.	
25	S. minimum (A. Br.) Hansg.	Stream/Ponds, Osmanabad. Pools, Parli.

Habitat and Locality

26	Scenedesmus abundans (Kirchn.) Chodat. v. brevicauda G. M. Smith.	Moti Talao, Jalna.
27	S. acuminatus (Lagerh.) Chodat.	Moti Talao, Jalna.
28	S. arcuatus (Lemm.) Lemm.	Stream, Jalna. Puddles, Nanded. Pools, Pali. Stream, Beed. Harsool lake, Aurangabad.
29	S. bijugatus (Turp.) Kuetz.	Harsool lake, Aurangabad. Puddles, Parbhani.
30	S. denticulatus Lagerh. v. australis Plays.	Ponds, Jalna. Pools, Aurangabad.
31	S. hystrix Lagarh,	Ponds, Osmanabad. Pools, Nanded.
32	S. longus Meyen v. brevis- pina G. M. Smith.	Moti Talao, Jalna.
33	S. obligus (Turp.) Kuetz	Stream, Jalna. Bindusara Dam, Pali.
34	S. opoliensis P. Richter	Stream, Jalna.
35	S. quadricauda (Turp.) Breb. v. quadrispina (Chodat).	Ponds, Osmanabad. Cisterns, Aurangabad.
36	S. quadricauda (Turp.) Breb. v. mestii G. M. Smith.	Pools, Pali.
37	Ulothrix aequalis Kuetzing	Stream, Osmanabad.
38	U. cylidriqum Prescott	Bindusara Dam, Pali.
39	U. subtilissima Rabenh.	Moti Talao, Jalna.
40	U. tenerrima (Kuetz.) Kuetz.	Pools, Pali.
	C. Tenerima (Ruciz.) Rugiz.	Stream, Osmanabad.
41	U. variabilis (Kuetz.) Kuetz.	Stream, Osmanabad.
42	Stigeoclonium lubrigum (Dillw.)	Stream, Jalna.
43	S. nanum Kuetz	Harsool lake, Aurangabad.
44	S. tenue (Ag.) Kuetz.	Stream, Osmanabad.
45	Aphanochaete polychaete (Hansigirg) Fritsch.	Ponds, Osmanabad.
46	Coleochaete orbicularis Pringsheim.	Ponds, Osmanabad.
47	Protococcus viridis Agardh	Walls, Aurangabad, Nanded, Parbhani.
48	Rhizoclonium hieroglyphicum (Ag.) Kuetz.	Streamlet, Aurangabad. Ponds, Nanded; Osmanabad, Parbhani.
49	Oedogonium echinospirale Lacerda.	Ponds, Osmanabad.
50	O. plagiostomum Wittr. ex. Hirn. V. gracilius Wittr. ex. Hirn.	Ponds and Streams, Pali.

	Name	Habitat and Locality
51	O. plusiosporum Wittr. ex Hirn.	Stream, Jalna.
52	O. poecilosporum Nordst. ex Hirn. V. minor Kamat.	Lake, Aurangabad.
53	O. spurium Hirn	Lake, Aurangabad.
54	O. suecicum Wittr. ex Hirn.	Ponds, Osmanabad.
55	O. tapeinosporum Wittr. ex	Puddles, Aurangabad.
56	Spirogyra condensata (Vouch) Kuetz.	Puddles, Aurangabad. Stream, Beed.
57	S. fragilis Jao	Puddles, Aurangabad.
58	S. gracilis (Hassall) Kuetz.	Moti Talao, Jalna.
59	S. hyalina Cleve	Stream, Beed.
60	S. irregularis Naegeli	Stream, Jalna.
61	S. macrospora (Rao) Krieger	Stream, Jalna. Ponds, Osmanabad. Pools, Nanded.
62	Zygnema guadrangulatum Jao	Ponds, Osmanabad.
63	Zygnemopsis sarvatiensis Iyengar.	Puddles, Aurangabad.
Eugl	ENOPHYCEAE:	
64	Euglena acus Ehrenberg	Moti Talao, Jalna.
65	E. charkcwiensis Swir	Ponds, Osmanabad. Pools, Nanded.
66	E. heimii Lefevre	Ponds, Osmanabad.
67	E. proxima Dang	Lake, Aurangabad.
6 8	E. sanquinea Ehr	Bindusara Dam, Pali.
69	E. spirogyra Ehr. v. supreme skuja.	Ponds, Osmanabad.
70	Phacus acuminatus Stokes	Ponds, Osmanabad.
71	P. platalea Drez	Puddle, Osmanabad.
72	P. undulatus (Skv.) Pochm.	Pools, Osmanabad. Stream, Pali.
73	Trachelomonas allia Drez. emend. Defl.	Stream, Pali.
74	T. armata (E) Stein. v. sparsigranosa Playf.	Stream, Pali.
75	T. armata (E). Stein. V Steinii Lamm. emend Defl.	Ponds, Osmanabad.
76	T. bacillifera Playf. v. ovalis Playf.	Ponds, Osmanabad. Pools, Nanded.
77	T. conica Playf	Ponds, Osmanabad.
7 8	T. granulosa Playf	Stream, Pali.
79	T. hispida (Party) Stein, emend Defi.	Lake, Aurangabad. Ponds, Osmanabad. Pools, Nanded. Puddles, Parbhani.

Habitat and Locality

80	T. hispida (Partim)) Stein emend Defl. v. punctata Lamm.	Moti Talao, Jalna.
81	T. nigra Swir	Stream, Beed.
82	T. oblonga Lemm. v. trun- cata Lamm.	Ponds, Osmanabad.

83 T. oviformis Drez. .. Moti Talao, Jalna. 84 T. scabratula (Playf.) Dafi .. Lake, Aurangabad.

85 T. sydneyensis Playf . . . Ponds, Osmanabad. Stream, Pali.

86 T. sydneyensis Playf. v. mini- Ponds, Osmanabad. ma Playf.

87 T. varians Defl. .. Moti Talao, Jalna.

T. volvocina Ehrenberg ... Pools, Pali. Ponds, Osmanabad.

Moti Talao, Jalna.
Pools, Nanded.
Ponds, Parbhani.
Lake, Aurangabi

Pools, \} Aurangabad.

88 Menoidium pellusidum Perty Ponds, Osmanabad.

DINOPHYCEAE

39 Gymnodinium albulum Lindem Pools, Pali.

90 G. rotundatum Klebs ... Lake, Aurangabad.

91 G. tartricum Wol. .. Moti Talao, Jalna. Pools, Pali.

XANTHOPHYCEAE

92 Botrydium granulatum
Greville.

(L.) Pools, Beed.
Puddles, Pali.
Puddles, Nanded, Aurangabad,
Parbhani, Osmanabad.

सत्यमव जयत

CYANOPHYCEAE

93 Microcystis aeruginosa Kuetz Ponds, Pali.
 94 Aphanothece castegnei (Breb.) Stream, Jalna. Pools, Pali.
 95 A. microscopica Naeg. Stream, Pali.
 96 A. naegelii Wartm. Ponds, Osmanabad.

97 A. pallida (Kuetz.) Rabenh. Moist soils, Osmanabad, Nanded, Aurangabad, Parbhani.

98 Chroococcus minutus (Kuetz.) Puddle, Aurangabad. Naeg. Pools, Beed.

99 C. turgidus (Kuetz.) Naeg. .. Cisterns, Aurangabad, Moist soils, Aurangabad.

100 C. turicensis (Naeg.) Hansg. Moti Talao, Jalna.

101 Gloeothece geoppertiana .. Cisterns, Aurangabad. (Hilse) Forti.

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	Name	Habitat and Locality
102	Merismopedia elegans A. Br.	Moti Talao, Jalna.
103	M. glauca (Ehrenb.) Naeg.	Stream, Beed. Pools, Pali. Stream, Aurangabad.
		Ponds, Osmanabad. Moti Talao, Jalna.
104	M. punctata Meyen	Moti Talao, Jalna. Pools, Beed. Streamlet, Aurangabad.
105	Synechocystis aquatilis Sauv.	Moti Talao, Jalna.
106	Myxocarcina spectabilis Geitler.	Puddle, Aurangabad.
107	Spirulina major Kuetz. ex Gomont.	Ditches, Jalna.
108	S. nordstedtii Gom	Moti Talao, Jalna.
109	Arthospira balkrishnanii Kamat,	Moti Talao, Jalna.
110	Oscillatoria amphigranulata Van. Goor f. conica Kamat.	関われ
111	O. boryana Bory ex Gomont	Dam wall, Pali.
	(SIEE)	Pools, Jalna. Stream, Osmanabad.
	A PARTS	Gutters, Aurangabad.
112	O. formosa Bory ex Gomont	Gutters, Aurangabad. Gutters, Osmanabad.
113	O. jenensis G. Schmid:	Streamlets, Aurangabad.
114	O. mougeotii Kuetz	Dirty walls, Aurangabad, Nanded, Beed, Osmanabad, Parbhani.
115	O. okeni Ag. ex Gomont	Gutters, Aurangabad, Pali, Nanded, Beed, Osmanabad, Jalna, Parbhani.
116	O. okeni Ag. ex Gom. V. gracilis Kuetz, ex Gom.	Moti Talao, Jalna.
117	O. princepe Vauch. ex Gom.	Moti, Talao, Jalna, Ponds/stream, Osmanabad, Aurangabad. Pools, Pali.
118	O. pseudogeminata G. Schmid f. longa Kamat.	Stream, Osmanabad.
119	O. quadripunctulata Bruhl. et Nosw as v. unigranulata R. N. Singh f, ahmedabaden- sis Kamat.	Moti Talao, Jalna. Dam, Pali.
120	O rubescens D. C. ex. Gomont v. curvata Kamat.	Moti Talao, Jalna.
121	O. rubescens D. C. ex. Gomont v. kolhapurensis Kamat,	Dam wall, Osmanabad.
122	O. tambi Woronich	Ponds, Osmanabad.
123	O. ulrichii Prat	Moti Talao, Jalna. Lakes, Aurangabad.

Habitat and Locality

124	Phormidium anomala C. B. Rao.	Pools, Beed. Moti Talao, Jalna.
125	P. autumnale (Ag.) Gom	Moist soils, Nanded. Moist soils, Osmanabad.
126	P. frigidum Fritsch	Stagnant water, Jalna. Stream Pools, Beed.
127	P. pristelei F. E. Fritsch	Walls, Osmanabad. Puddle, Nanded.
128	P. uncinnatum Gom	Pools, Beed. Moist soil, Aurangabad.
129	Lyngbya hirgei G. M. Smith	Moti Talao, Jalna.
130	L. shackletoni W. et. G. S. West.	Pools, Streams, Pali.
131	L. gandhii Kamat	Lake, Aurangabad.
132	L. infixa Fremy	Cistern, Aurangabad.
133	Microcoleus chthonoplastes Thuret ex Gomont.	Moist soils, Aurangabad, Nanded, Beed, Parbhani.
134	Schizothrix rubella Gom	Moist soils, Beed.
135	Calothrix fusca (Kuetz.) Born. et Flah.	Ponds, Osmanabad.
136	C. karnatakensis Gonzalves et Kamat V. major Gonzalves ves et Kamat,	Ponds, Osmanabad.
137	C. marchica Lamm,	Puddle, Beed.
138	Dichothrix willei Gardner	Cisterns, Aurangabad, Nanded.
139	Gloeotrichia pilgeri Schmidle	Ponds, Osmanabad.
140	G. raciborskii Wolosz	Ponds, Osmanabad.
141	Microchaeta uberrima Carter	Ponds, Osmanabad.
142	Aulosira fertilissima Ghose v. tenuis C. B. Rao.	Puddle, Beed.
143	Nostoc piscipale Kuetz. ex Born, et Flah.	Ponds, Osmanabad.
144	Anabaena volzii Lamm	Pools, Stream, Beed.
145	Scytonema mirabile (Dillw.) Born,	Puddle, Beed.
19.	ALGAE OF VIDARBHA	

(After N. D. Kamat, 1975, J. B. N. H. S., 72: 450-476)

CHLOROPHYCEAE

Name	Locality
Chlanydomonas globosa Snow	 Amravati, Katol.
C. snowii Printz	 Akola.
Gonium pectorale Muell	 Amravati, Bhandara, Tiroda.
Eudorina elegans Ehrenberg	 Bhandara.
Sphaerocystis schroestri Chodat	 Bhandara, Tumsar, Tiroda,

Name	Locality
Gloeocystis ampla (Kuetz.) Lagarh.	Umred.
G. gigas (Kuetz.), Lagerh	Amravati.
Tetraspora gelatinosa (Vauch.) Desvaux.	Yeotmal.
T. lacustris Lemm	Bhandara,
Elakatothrix viridis (Snow) Printz	Amravati, Khamgaon, Akola, Bhandara.
Micractinium pusillum Fresen	Bhandara.
Dictyosphaerium pulchellum Wood	Bhandara,
Dimorphococcus lunatus A. Br	Umred, Bhandara.
Schroedria indica Philipose	Amravati.
S. robusta Korsh	Wardha.
_ ,	Amravati,
Korshikoviella gracilipes (Lamb.) Silva.	Amravati,
Pediastrum boryanum (Turpin) Meneghini.	Dahegaon, Amravati, Tiroda.
P. duplex Meyen	Mansar, Yeotmal, Bhandara.
P. duplex Meyen v. clathratum (A. Br.) Lagerh.	Bhandara.
P. duplex Meyen v. cohaerens Bohlin	Mansar, Tumsar, Bhandara, Tiroda.
P. duplex Meyen v. gracilimum West et West.	Bhandar a .
P. integrum Naeg. v. perforatum Racib.	Tiroda.
P. muticum Kuctz	Mansar.
P. simplex Meyen	Amravati, Bhandara.
P. simplex Meyen v. duodenarium (Baily) Rabenh.	Amravati, Bhandara.
P. tetras (Ehrenb.) Ralfs	Umred, Mansar, Amravati.
P. tetras (Ehrenb.) Ralfs v. tetraedron (Corda) Hansg.	Pavanar.
Sorastrum americanum (Bohlin) Schmidle.	Mansar, Tumsar, Bhandara.
S. americanum (Bohlin) Schmidle v. undulatum Smith.	Amravati.
S. spinulosum Naeg	Amravati, Tumsar, Bhandara.
Coelastrum cambricum Arch. v. intermedium (Bohlin) G. S. West.	Amravati, Umred, Tumsar, Bhandara, Tiroda.
C. microporum Naeg	Tumsar, Tiroda.
C. reticulatum (Dang.) Senn	Bhandara.
Westella botryoides (W. West) De Wild.	Bhandara.
Nephrocytium hydrophilum (Turn.) Wille.	Amravati.
N. obseum West et West	Amravati.

Name Locality

Name	Locality
Trochiscia reticulatis (Reinsch) Hansg.	Mansar.
Oocystis borgei Snow	Chandrapur, Tumsar, Bhandara, Tiroda.
O. elliptica W. West	Umred, Amravati.
O. gigas Arch	Amravati.
O. macrospora (Turn.) Brunnth	Mansar.
O. pusilla Hansg	Tumsar, Bhandara.
O. solitaria Wittr. v. major Wille	Mansar.
Gloeotaenium leitsbergianum Hansg.	Amravati, Bhandara.
Ankistrodesmus convolutuz Corda	Bhandara.
A. falcatus (Corda) Ralfs	Umred, Mansar, Amravati, Tiroda.
A. falcatus (Corda) Ralfs. v. mirabilis (West et West) G. S. West.	Amravati.
A. falcatus (Corda) Ralfs v. tumidus	Amravati.
A. spiralis (Turn.) Lemm	Umred, Bhandara.
Selenastrum bibraianum Reinsch	Umred.
Kirchneriella lunaris (Kirchn.) Moebius.	Bhandara.
K. lunaris (Kirchn.) Moebius v. irregularis G. M. Smith.	Umred.
K. subsolitaria G. S. West	Bhandara.
Tetraedron hastatum (Reinsch) Hansg.	Amravati.
T. minimum (A. Br.) Hansg	Amravati.
T. pentaedricum West et West	Bhandara.
T. pusillum (Wall.) West et West	Bhandara.
T. trigonum (Naeg.) Hansg	Amravati, Bhandara.
Scenedesmus arcuatus Lemm. v. platydisca G. M. Smith.	Umred, Bhandara.
S. bijuga (Turp.) Lágerh	Bhandara,
S. bijuga (Turp.) Lagerh. v. alternans (Reinsch) Hansg.	Tumsar, Bhandara.
S. bijuga (Turp.) Lagerh. v. alternans (Reinsch) Hansg, f. parvus G. M. Smith.	Wardha, Chandrapur.
S. denticulatus Lagerh	Bhandara.
S. denticulatus Legerh. v. australis Play f.	Bhandara.
S. dimorphus (Turp.) Kuetz	Chandrapur, Amravati, Tumsar, Bhandara.
S. hystrix Lagerh	Bhandara.
S. longus Meyen	Umred.
S. longus Meyen v. minutum G. M. Smith.	Bhandara.

Name	Locality
S. obliguus (Turp.) Kuetz	Tumsar, Bhandara.
S. quadricauda (Turp.) De Breb. v. longispina (Chodat) G. M. Smith.	Chandrapur.
S. quadricauda (Turp.) De Breb. v. maximus West et West.	Wardha, Tumsar, Bhandara.
Crucigenia rectangularis (Naeg.) Gay	Amravati.
Tetrallantos lagerheimii Tailing	Umred.
U. lothrix acqualis Kuetz	Umred.
U. cylindricum Prescott	Wardha,
U. subconstricta G. S. West	Umred.
U. tenerrima (Kuetz.) Kuetz	Umred, Amravati, Tumsar.
Cylindrocapsa oedogonioides Randhawa.	Mansar,
Stigeoclonium attenuatum (Hazen) Collins	Umred.
S. hubneri Heering	Tumsar.
S. lubricum (Dillw.), Kuetz	Amravati,
S. nanum Kuetz	Umred.
Chaetophora pisciformis (Roth) Agardh.	Mansar.
Coleochaete irregularis Pringsheim	Tumsar.
C. orbicularia Pringsheim	Mansar, Amravati, Tumsar.
C. scutata De Breb	Tumsar, Tiroda.
C. soluta (De Breb.) Pringsheim	Tiroda.
Protococcus viridis C. A. Agardh	Amravati.
Fritschiella tuberosa Iyongar	Sakoli.
Chaetosphaeridium globosum (Nordst.) Klebahn.	Tiroda.
C. pringsheimii Klobahn f. conferta Kelbahn.	Tumsar.
Gomontia holdenii Collins	Umred.
Rhizoclonium hieroglyphicum (C. A. Ag.) Kuetz.	Amravati, Bhandara.
Pithophora oedogonia (Mont.) Wittr.	Amravati, Dahegaon, Katol. Khamgaon, Gondia, Sakoli. Wardha, Tiroda.
Cladophora glomerata (L.) Kuetz	Amravati, Lonar, Sakoli, Yeot-mal.
Oedogonium aster Witte, ex Hirn	Amravati,
O. australianum Hirn	Mansar.
O. autumnale Wittr. ex Hirn	Umred.
O. clavam Wittr. ex Hirn	Tiroda.
O. cardiacum (Hans.) wittr. ex Hirn. f. interjectum Hirn.	Bhandara.
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O. crispum (Hans.) Wittr. ex Hirn.. Umred.

Name Locality

Name	Locality
O. elegans West et West v. america num Jao.	- Tiroda.
O. ellipsoideum Jao	. Mansar,
O. flexuosum Hirn	. Yeotmal.
O. inconspicum Hirn	. Mansar.
O. inframediale Jao	. Mansar.
O. obesum (Wittr.) Hirn	Bhandara.
O. obtruncatum wittr. ex Hirn v. ellipsoideum wittr. ex Hirn	Bhandara.
O. inframediala Jao	. Mansar.
O. obesum (Wittr.) Hirn	. Bhandara.
O. obtruncatum Wittr. ex Hirn v. ellipsodeum Wittr. ex Hirn	Bhandara.
O. plagiostomum Wittr. ex Hirn v. gracilis wittr. ex Hirn	Bhandara.
O. poecilosporum Nord. et Hirn	Tiroda.
O. porrectum Nordst. ex Hirn	. Mansar.
O. pringsheimii Cramer. Wittr. ex Hirn v. nordstedtii wittr. ex Hirn	Bhandara.
O. pseudospirale Nygaard	Bhandara.
O. pusillum Kirchn. ex Hirn	Amravati.
O. santurcense Tiff.	Bhandara.
O. suhaerolatum Jao	Amravati.
O. tapeinosporum wittr. ex Hirn	Amravati, Tiroda.
O. undulatum (Breb.) Al. Braun; Wittr. ex Hirn	Amravati, Bhandara, Wardha.
O. urbicum Wittr. ex Hirn	Bhandara.
O. virceburgense Hirn	Amravati, Tiroda,
Bulbochaete diamesandria Nordstedt ex Hirn	Tiroda.
B. lagoensis Wittr. ex. Hirn	Tiroda.
B. variana wittr. ex Hirn	Amravati.
Netrium digitus (Ehrenb.) Itzig. et Roth v. lamellosum (Breb.) Gronbl.	Tiroda.
Cylindrocystis americana West et west v. minor Cushm.	Mansar.
Gonatozygon aculeatum Hast,	Mansar.
G. kinahani (Arch.) Rabenh	Mansar,
G. monotaenium De Bary	Umred, Tumsar, Sakoli, Bhandara, Tiroda.
G. pilosum Wille	Mansar.
Pleurotaenium baculoides (Roy et Biss.) Playf.	Mansar, Tiroda.

Name	Locality
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Name	Locality
P. ehrenberdii (Breb.) De Bary	Tumsar.
P. elatum (Turner) Borge v. sub- undulatum Hirano.	
P. indicum (Grun.) Lund	Bhandara, Tumsar.
P. inermium (Moeb.) Hirano	Umred, Chandrapur, Bhandara.
P. simplicissimum Gronbl	Tumsar.
P. simplicissimum Gronbl. v. semi- undulatum Hirano.	Umred, Chandrapur, Tumsar,
P. ovatum Nordst	Chandrapur, Bhandara, Mansar.
P. subcoronulatum (Turn.) West et West.	Mansar.
P. trabecula (Ehrenb.) Naeg	Amravati, Umred.
P. trabecula (Ehrenb.) Naeg. v. maximum (Reinsch) Roll. f. constrictum Scott et Prescott,	
P. trabecula (Ehrenb.) Naeg. f. clavata (Kuetz) West et West.	3 ~
P. trabecula (Ehrenb.) Naeg. v. rectum (Delp.) West et West.	Umred, Amravati, Tiroda.
Closterium acerosum (Schrank) Ehrenberg.	20
C. acerosum (Schrank) Ehrenb. f. rectum Scott et Prescott.	Chandrapur.
C. aciculare West et West	The state of the s
C. acutum Breb	2017-2 + 2
C. acutum Breb. v. variable (Lemm.) Krieger.	Satnavri, Sakoli
C. calosporum Wittr.	Wardha,
C. calosporum Wittr. v. brasiliense Borg.	
C. cornu Ehrenb	Satnavri, Yavatmal, Umred.
C. cornu Ehrenb. v. upsaliense Nordst.	
C. cynthia De Not	Umred, Tiroda.
C. dianae Ehrens	Umred, Amravati, Bhandara.
C. ehrenbergii Menengh	Umred.
C. gracile Breb	Amravati, Chandrapur.
C. idiosporum West et West	Yeotmal.
C. incurvum Breb	Amravati, Sakoli, Tumsar.
C. jenneri Ralfs v. tenue Croasdole	Umred, Bhandara.
C. kuetzingii Breb	Umred.
C. lanceolatum Kuetz	Satnavri, Amravati.
C. leibleinii Kuetz	Mansar.
C. libellula Focke	Tiroda.
C. lineatum Ehrenb	Mansar.
C. littorale Gay	Umred, Tumsar, Bhandara.

Name		Locality
C. macilentum Breb		Tumsar, Sakoli.
C. parvulum Naeg.		Satnavri, Umred, Chandrapur, Tumsar.
C. setaceum Ehrenb,		Umred.
C. sinense Lutkem		Satnavri, Tumsar.
C. tumidulum Gay		Amravati, Yeotmal.
C. tumidum Johnson		Mansar.
C. venus Kuetz		Mansar.
C. venus Kuetz. v. incurvi Krieger.	ım (Breb.)	Amravati.
Cosmarium abbreviatum R	acib	Bhandara.
C. abbreviatum Racib. f Messik.	. pygmaea	Amravati.
C. amoenum Breb		Umred, Bhandara.
C. auriculatum Reinsch		Satnavri, Amravati, Chandrapure Bhandara.
C. bengalense (Grun.) Tur	$n \sim \sqrt{3} \delta$	Umred, Tumsar, Bhandara.
C. biloculatum Breb. v. su tum Krienger et Gerloff		Umred.
C. botrytis Menegh.		Amravati.
C. zeylanicum West et We Scott et Prescott.	est f. minus	Mansar.
C. connatum Breb	124	Amravati.
C. contractum Kirchn.	100	Umred,
C. contractum Kirchn. f. (Roy) West et West.	jacobsenii	Amravati, Mansar.
C. contractum Kirchn. v. e (Elfv.) West et West.	llipsoideum	Mansar.
C. contractum Kirchn v (Delp.) West et West.	. minutum	Mansar.
C. contractum Kirchn. v. i Racib.		_
C. cucurbitinium (Biss.) Lui		Mansar, Tiroda.
C. cucurbitinum (Biss.) v, grande Gronbl.		
C. depressum (Naeg.) I intermedium (Gutw.) M	essik.	Akola.
C. difficile Lutken v. dilat	um Borge.	Mansar.
C. dispersum Johnson		Bhandara.
C. dubicum Borge		Amravati, Tiroda.
C. dybowakii Gutw.		Bhandara.
C. elegantissimum Lund. West.		Mansar.
C. exiguum Arch		Umred.
C. freemanii West et West		Umred.
C. furcatospermum West koreana Skv.	et west v.	Amravati.

Name	Locality
C. fusceense Hirano	Mansar, Akola.
C. garrolense Roy et Bias. v. crassum Jao.	Amravati.
C. granatum Breb	Amravati.
C. hammeri Reinsch v. homaloder- mum (Nordat.) West et West.	
C. hammeri Reinsch v. protuberans West et West.	Amravati.
• • • • • • • • • • • • • • • • • • • •	Amravati, Tumsaı.
C. impressulum Elfv. v. octangularis Hirano.	Tiroda.
C. inconspicuum Arch	Amravati.
C. infirmum Gronbl. v. minus (Gronbl.) Krieger et Garloff.	
	Amravati, Umred.
C. laeve Rabenh, v. depressum Croasdale.	Amravati, Tumsar.
C. 1	Bhandara.
C. lunatum Wolle v. sparsum (Turn.) Krieger et Garloff.	169
(Reinsch) Krieger.	Amravati, Akola.
C. lundelli Delp. v. corruptum (Turn.) West et West.	Tiroda.
C. lundelli Delp. v. ellipticum West	Mansar, Bhandara, Tiroda.
C. maculatum Turn	
C. mansangense West et West	1 - 1
C. margaritatum (Lund) Roy et Bisset.	Akola, Jawahar Nagar.
C. margaritatum (Lund) Roy et Bisset f. minor (Boldt) West et West,	Umred, Jawahar Nagar, Bhandara.
C. moniliforme (Turp.) Ralfs v. panduriforme (Heimerl) Schmidle.	Bhandara.
C. nymannianum Grun	
C. nymannianum Grun, v. brevis (Wille) Krieger et Gerloff.	Umred.
C. obsoletum (Hantzsch) Reinsch v. sitvense Gutw.	Umred,
C. obtusatum Schmidle	Paynar, Mansar, Tumsar, Bhandara.
C. orthostichum Lund	Yeotmal.
Messik.	Yeotmal.
C. phaseolus Breb. v. achondrum Boldt.	Tumsar.
C. polonicum Racib	Tumsar.

Name Locality

Name	200
C. polygonum (Naeg.) Arch	Mansar.
C. portianum Arch	Akola, Tiroda.
C. portianum Arch. v. nephroideum Wittr.	Amravati.
C. pseudadoxum Jao	Amravati.
C. pseudoconnatum Nordst	Tiroda.
C. pseudohexagonoides Bruhl et. Biswas.	Amravati.
C. pseudopyramidatum Lund	Tiroda.
C. pseudopyramidatum Lund v. borgei Krieger et Gerloff.	Bhandara, Tumsar.
C. pseudopyramidatum Lund. v. carniolicum Lutk.	Tumsar, Jawahar Nagar.
C. pseudopyramidatum Lund. v. rotundatum Krieger et Gerloff.	Tumsar.
C. pyramidatum Breb	Amravati.
C. pyramidatum Breb, v. convexum Krieger et Gerloff.	Amravati.
C. quardratulum (Gay) De Toni	Pavnar.
C quardratum Ralfs	Tiroda.
C. quadratum Ralfs f. Willei West et West.	1.8
1.781 # 7	Bhandara.
C. quinarium Lund	Bhandara.
C. ralfsii Breb. v. alpinum Racib	
C. ralfsii Breb. v. montanum Racib.	Umred.
C. rectangulare Grun, v. africanum	Umred.
C. regnellii Wille v. kerguelense Krieger et Gerloff.	Amravati.
C. regnellii Wille	Dahegaon.
C. reniforme (Ralfs) Arch	Jawahar Nagar.
C. repandum Nordst. f. minor West et West.	Sakoli.
C. retusiformae (Wille) Gutw	Mansar, Tumsar.
C. sexangulare Lund	Amravati.
C. sexangulare Lund f. minimum Nordst.	Amravati, Tiroda.
C. sikkimense Turn	Amravati.
C. speciosum Lund. v. ingrassatum Insam et Krieger.	Jawahar Nagar.
C. striolatum Naeg. v. nordestedtii (Moeb.) Krieger.	Umred.
C. subacutangulum Gronbl	Jawahar Nagar.
C. sublatere-undateim West et West	Umred.
C. subreiuschii Schmid. v. ocellatum West et West.	Amravati.

Name	Locality
C. subtransiens Croasdale	Tiroda.
C. subtumidum Nordst	Amravati.
C. subtumidum Nordst. f. minor Krieger.	Amravati.
C. subtumidum Nordst. v. rotundum Hirano.	Jawahar Nagar.
C. supraconnatum (Turn.) Krieger et. Gerloff.	Bhandara,
C. striolatum Naeg	Bhandara.
C. trachydermum West et. West	Satnavri,
C. trachydermum Lund v. nordstedtii Gutw.	Tiroda.
C. trafalgaricum Wittr	Wardha.
C. trilobatum Reinsch v. printzii Messik.	Umred.
C. triplicatum Wolle	Tumsar.
C. tryolicum (Nordst.) Krieger et Gerloff.	Amravati.
C. tuddalense Strom	Sakoli.
C. tumidum Lund	Tiroda.
C. undulatum Corda ex Ralfs.	Umred.
C. undulatum Corda ex. Ralfs v. crenulatum (Naeg.) Wittr.	Wardha.
C. undulatum Corda ex. Ralfs v. minutum Wittr.	Amravati, Bhandara, Jawahar Nagar.
C. undulatum Corda ex. Ralfs v. wollei W. West.	Tiroda.
C. variolatum Lund. v. rotundatum (Krieger) Messik.	Bhandara.
C. venustum (Breb.) Arch u. brevis Bernard.	Satnavri,
C. virde (Corda) Josh, f. minor W. West,	Wardha.
C. virde (Corda) Josh. v. hibernicum (W. West) Krieger et Gerloff.	Bhandara.
C. wittrockii Lund	Amravati.
Euastrum bidentatum Naeg v. koreana (Skv.) Okada.	Umred.
E. binale (Turp.) Ehrenb. v. sectum Turn.	Dahegaon.
E. ceylanicum (West et West) Krieger	Tumsar, Bhandara.
E. denticulatum (Kirchn.) Gay	Mansar.
E. divergens Josh v. ornatum (Borge) Schm.	Bhandara.
E. elegans (Breb.) Kuetz. v. pseudoe- legans (Turn.) West et West.	Umred, Mansar, Amravati.
E. inerme (Ralfs) Lund	Tiroda.

Locality

E. insulare (Witter.) Roy	Amravati, Jawahar Nagar.
E. irregulare Gonz. et Gang	Satnavri, Amravati, Pavnar.
E. turneri West	Bhandara.
E. lutkemuelleri Duc v. carniolicum (Lutkem.) Krieger.	Mansar.
E. platycerum Reinsch	Umred, Bhandara, Tumsar.
E. spinulosum Delp	Amravati, Umred, Tumsar, Sakoli, Bhandara.
E. spinulosum Delp. v. bellum Scott et Prescott.	Jawahar Nagar.
E. subamoenum Schmidle	Bhandara.
E. sublobatum Breb	Amravati.
E. sublobatum Breb. v. obtusatum (Gutw.) Krieger.	Amravati, Mansar.
E. turneri West	Bhandara.
Microsterias crux-melitensis	Tumsar.
(Ehrenb.) Hans.	1
M. foliacea Bailey	Umred, Mansar, Tiroda.
M. mahabaleshwarensis Hobs. v. chauliodon Scott et Prescott.	Mansar.
M. pinnatifida (Kuetz.) Ralfs	Umred, Tumsar, Bhandara.
M. pinnatifida (Kuetz.) Ralfs v. pseudoscitans Gronbl.	Tumsar.
M. radians Turn	Umred, Mansar, Tumsar.
M. radians Turn	Umred, Mansar, Tumsar. Umred, Bhandara.
11 Jacks 10	77770°4M
M. zeylanica Fritsch	Umred, Bhandara.
M. zeylanica Fritsch	Umred, Bhandara. Mansar.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar. Umred, Sakoli.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar. Umred, Sakoli. Sakoli. Mansar.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar. Umred, Sakoli. Sakoli. Mansar. Bhandara.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar. Umred, Sakoli. Sakoli. Mansar. Bhandara.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar. Umred, Sakoli. Sakoli. Mansar. Bhandara. Amravati.
M. zeylanica Fritsch	Umred, Bhandara. Mansar. Mansar. Mansar. Mansar. Mansar. Mansar, Tiroda. Mansar. Umred, Sakoli. Sakoli. Mansar. Bhandara. Amravati. Umred, Bhandara.

Name	Locality
S. gracile Ralfs	Tiroda.
S. hantzii Reinsch v. japonicum Roy et Bisset.	Mansar.
S. indentatum West et West f. minus Scott et Prescott.	Umred.
S. iotanum Wolle v. longatus Hirano	Mansar.
S. iotanum Wolle v. tortum Teiling	Amravati, Tiroda.
S. leptodermum Lund v. capitatum Hirano.	Mansar.
S. longispinum (Bail). Arch. v. bidentatum (Wittr.) West.	Mansar.
S. megacanthum Lund	Mansar.
·	Akola, Tiroda.
S. orbiculare Ralfs v. depressum Roy et Bisset.	Amravati, Bhandara.
S. orbiculare Ralfs v. ralfsii West et West.	Tumsar.
4.27 P. (1.27 P. (1.2	Akola.
S. pinnatum Turn, v. subpinnatum (Schm.) West et west f. robustum Krieg.	Umred.
S. polymorphum Breb. v. pygmaeum Gronbl.	Bhandara.
S. punctulatum Breb	Umred, Amravati.
S. quadricornutum Roy et Bisset	Amravati.
West,	Amravati.
S. saltans Josh. v. javanicum Scott et Prescott.	Umred.
S. sexangulare (Bulnh.) Lund	Umred.
S. sexangulare (Bulnh.) Lund v. crassum Turn.	Umred.
,	Mansar.
S. tohopekaligense Wolle v. insigne West et West.	Mansar.
3 · 3	Umred,
Sphaerozosma punctatum West et West.	
` ,	Umred.
Spondylosium nitens (Wall) Arch. f. majus Turn.	Umred.
S. planum (Wolle) West et West	
Onychonema laeve Nordst. v. latum West et West,	
O. laeve Nordst. v. micracanthum Nordst.	Umred.
Hyalotheca dissiliens (Smith) Breb.	Amravati.

Locality Name Tiroda. H. indica Turn Umred. H. mucosa (Mert.) Ehrenb ... Amravati. H. undulatum Nordst Amravati. Desmidium aptogonum Breb Amravati, Bhandara. D. aptogonum Breb. v. ehrenbergii Kuetz. D. psevdostreptonema West et West Umred, Titoda. Tiroda. D. quadraium Nordst. Umred, Tiroda. Streptonema trilobatum Wall Amravati. Mougeotia banglorensis lyengar Amravati. M. calcarca (Cleve) Wittr ... Akola. M. floridana Transcau Tiroda. M. maltae Skuja Mansar. M. microspora Taft ... Amravati. M. reinschii Transeau Tumsar. M. sphaerocarpa Wolle Tiroda. M. transeau Collins ... Amrayati, Tiroda. Zvgnema czurdae Randhawa Tiroda. Z. gangeticum Rao ... Amravati. Z. globosum Czurda ... Amravati. Zygnemopsis minuta Randhawa Z. sphaerospora Randhawa Bhandara. Tiroda. Spirogyva azygospora R. N. Singh . . (Randhawa)... Akola. S. bichromatophora Transeau. Wardha. S. biformis Jao Tiroda. S. corrugata Transeau Satnavri. S. diluta Wood Tiroda. S. fennica Cedercreutz Pavnar. S. fuellebornei Schmidle Chandrapur. S. smithii Transeau Amravati. S. weberi Kuetz **EUGLENOPHYCEAE** Chandrapur, Umred. Euglena acus Ehrenb Khamgaon. E. acus Ehrenb. v. hyalina Klebs Amravati. E. acus Ehrenb. v. oyei Defl Chandrapur. E. acus Ehrenb. v. rigida Hubner Akola. E. allornei Deft. Akola. E. caudata Hubner Chandrapur, Akola. E. charkowiensis Swir Chandrapur. E. charkowiensis Swir. v. minor ... Skovortz.

E. chortes Schiller

Umred, Bhandara.

Name	Locality
E. gaumeri Allorge et Lefevre	Amravati.
E. gracilis Klebs	Umred, Khamgaon.
E. ignobilis L. P. Johnson	Akola.
E. limnophila Lemm	Satnavri.
E. mucifera Mainx	Umred.
E. multiformis Schiller	Akola.
E. oxgyu ris Schmarda	Umred, Khamgaon.
E. pusilla Playfair	Umred.
E. spirogyra Ehrenb	Umred.
E. spirogyra Ehrenb. v. suprema Skuja.	Mansar, Tumsar.
E. tripteris (Duj.) Klebs	Umred,
Phacus acuminatus stokes v. indica (Pochm.) Huber-Pestalozzi.	
P. acuminatus Stokes v. variabilis Lemm.	Amravati, Mansar.
P. angulatus Pochm	Bhandara.
P. caudatus Hubner	Umred,
P. circumflexus Pochm	Umred.
P. contortus Bourr	Umred.
P. curvicauda Swir	Amravati, Umred, Wardha.
P. sphippion Pochm	Chandrapur.
P. longicauda (E.) Duj. v. major swirenko.	Umred.
P. longicauda (E.) Duj. v. rotunda (Pochm.) Huber-Pestal.	Amravati, Akola, Chandrapur, Tumsar.
P. mangini Lafty	
P. minutus (Play f.) Pochm	Satnavri, Bhandara.
P. orbicularis Hubn	Umred, Bhandara.
P. pekinensis Skvortz	Khamgaon.
P. platalea Drez	Amravati, Mansar, Bhandara.
P. pleuronectes (O. F. M.) Duj	Umred.
P. pseudonordstedtii Pochm	Umred,
P. stokesii Lemm. f. minor Conard	Wardha.
P. swirenkoi Ekvortz	Wardha.
P. thrombus Pochm	Umred.
P. tortus (Lemm.) Skv	Amravati, Bhandara.
Trachelomonas allia Drez. emend, Defl.	
T. armata (E.) Stein	Umred.
T. armata (E.) Stein v. longispina Playf.	
T. armata (E.) Stein v. steinii Lemm. em. Defl.	Amravati, Bhandara.
T. bacillifera Playf	Chandrapur.

Name	Locality
T. bacillifera Playf. v. minima Playf	Bhandara.
T. bernardinensis W. Vischer em. Defi.	
T. conica Playf	Chandrapur.
T. cylindrica E. sec. ex Playf. v. decollata Playf.	Amravati.
T. dubia Swir. em. Defl. v. lata Defl	Mansar.
T. dybowskii Drez	Bhandara.
T. globularis Lemm. (Awer.) v. boyeri (Palmer) Conr.	Bhandara.
T. hispida (Perty.) Stein em. Defl	Amravati, Chandrapur, Mansar, Tumsar.
T. hispida (Perty) Stein em. Defl. f. recta Defl.	Bhandara.
T. hispida (Perty) Stein em. Defl. v. coronata Lemm.	Amravati.
T. incertissima Defl	Amravati.
T. intermedia Dangeard	Mansar, Bhandara.
T. klebsii (klebs) Defl	Amravati, Bhandara.
T. lacustris Drez	Malegaon, Tumsar.
T. mangini Desl	Bhandara.
T. mucosa Swir. v. hyalina Skv.	Chandrapur.
T. oblonga Lemm	Akola, Mansar, Bhandara.
T. oblonga Lemm. v. australica Playf.	Chandrapur, Mansar.
T. oblonga Lemm. v. major Kamat	Umred.
T. oblonga Lemm. v. truncata Lemm.	CONTRACTOR
T. obtusa Palmer	Umred.
T. perforata Awering	Bhandara.
T. piscatoria (Fischer) Stokes	-
T. playfairi Defl	Umred.
T. pulcherrima Playf. v. minor Playf.	Amravati.
T. raciborskii Wolosz	Bhandara.
T. robusta Swir. em. Defl	Bhandara.
T. scabre Playf	Amravati.
T. scabra Playf. v. ovata Playf	Amravati.
T. similis Stokes	Bhandara.
T. superba Swir. cm. Defl	Tumsar.
T. sydneyensis Playf	Bhandara.
T. variana Defl	Umred, Bhandara.
T. volvocina Ehrenb	Amravati, Bhandara, Tiroda.
T. volvocina Ehrenb. f. minuta Fritsch	Amravati.
T. volvocina Ehrenb. v. derephora Conrad.	Mansar, Tumsar.

Name	Locality
T. volzii Lemm. v. cylindrica Playf	Umred.
T. volzii Lemm. v. pellucida Playf.	Umred.
T, wermelii Skv	Bhandara.
T. woycickii Koczwara v. bombay- ensis Kamat.	Mansar.
T. woycickii Koczwara v. pusilla Drez.	Amravati,
Strombomonas fluviatilis (Lemm.) Defl.	Bhandara.
	Chandrapur.
S. napiformis (Playf.)Defl. v. brevi- collis (Playf.) Defl.	Bhandara,
S. ovalis (Playf.) Defl	Chandrapur.
S. urceolata (Stokes) Defl Lepocinclis glabra Drez. f. minor Prescott.	Amravati.
L. marssonii Lemm. em. Conard	Tumsar.
Menoidium gracile Playf	Umred.
Anisonema acus Duj	Mansar.
XANTHOPHYCEAE	
Ophiocytium elongatum West et West.	Umred.
Botrydium granulatum (L.) Greville	Sakoli.
DINOPHYCEAE	
Cystodinium iners Geitler	Mansar.
Massartia stigmatica (Linden) Soiller.	·
Gymnodinium neglectum (Schill.) Lind.	Mansar.
G. rotundum Klebs	Bhandara.
Glenodinium gymnodinium Penard	Katol.
G. guadridens (Stein.) Schiller	Tiroda.
Peridinium bipes Stein	Tumsar.
P. cinctum (Muell.) Ehrenb	Chandrapur.
P. palustre (Lindem.) Lef. v. raciborskii (Wol.) Lef.	Bhandara.
P. penardiforme Lindem	Tiroda.
P. pusillum (Penard) Lemm	Amravati,
Суапорнусвав	
Microcystis aeruginosa Kuetz	Tumsar, Tiroda.
M. flos-aquae (Witrr.) Kirchn	Tumsar.
Aphanocapsa grevillei (Hans.) Rabenh.	Satnavri.
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Name Locality

Name	Locality
A. testacea Naeg	Tiroda.
Aphanothece castagnei (Breb.) Rabenh.	Bhandara.
A. heterospora Rabenh	Tiroda.
A. microscopica Naeg	Tiroda, Bhandara.
A. pallida (Kuetz.) Rabenh	Mansar, Chandrapur, Khamgaon.
Gloeocpasa muralis Kuetz	Amravati.
Gloeothece geoppertiana (Halse) Forti.	Wardha.
G. rupestris (Lyngby) Born	Khamgaon.
G. samoensis Wille	Amravati.
Chroococcus minor (Kuetz.) Naeg	Amravati.
C. minutus (Kuetz.) Naeg	Wardha, Khamgaon.
C. minutus (Kuetz.) Naeg. v. obliteratus (Richt.) Hansg.	Akola.
C. pallidus Naeg	Wardha.
C. spelaeus Ercegovic	Tiroda.
C. turgidus (Kuetz.) Naeg	Wardha.
C. turgidus (Kuetz.) Nacg. v. maximus Nygaard.	Tiroda.
C. turicensis (Naeg.) Hansg	Amravati, Khamgaon.
C. westii (W. West) Boye-Pet	Yeotmal, Tumsar, Bhandara.
Merismopedia elegans A. Br.	Wardha, Tiroda.
M. glauca (Ehrenb.) Naeg	Jawahar Nagar, Tiroda, Wardha.
M. punctata Meyen	Wardha, Chandrapur, Pavnar.
M. tenuissima Lemm.	Amravati,
Synechococcus cedrorum Sauv	Amravati.
S. aguatilis Sauv	Amravati.
S. crassa Woronic	Amravati.
S. sallensis Skuja	Amravati.
Myxosarcina burmensis Skuja	Bhandara, Tiroda.
M. spectabilis Geitler	Umred.
v. glabra C. B. Rao.	Yeotmal.
Borzia trilocularis Cohn	Amravati, Khamgaon.
Spirulina major Kuetz. ex. Gomont	Amravati, Wardha, Tiroda.
S. meneghiniana Zanard	Wardha, Lonar.
S. princeps West et West	Tumsar.
S. subsalsa Orest. v. crassior Virieux	Lonar.
Arthrospira platensis (Nordst.) Gomont.	Yeotmal.
A. tenuis Bruhlet Biswas	Amravati.
Oscillatoria agardhii Gom	Gondia.
O. amphibia Ag. ex Gom	Wardha, Mansar, Tumsar.
O. angusta Koppe	Satnavri.

Name	Locality
O. annae Van Goor	Wardha.
O. boryana Bory ex Gom	Yeotmal.
O. brevis (Kuetz.) Gom	Akola, Tiroda,
O. chalybea (Mertens) Gom	Amravati, Akola, Lonar.
O. claricentrosa Gardn	Umred.
O. cortiana Menegh, v. minor Kamat	Chandrapur.
O. decolorata G. S. West	Umred.
O. formosa Bory ex Gom	Amravati.
O. geminata Menegh. ex. Gom	Katol.
O. jasorvensis Vouk	Tiroda.
O. mougeotii Kuetz	Satnavri, Yeotmal, Umred.
O. nigro-viridis Thwaites	Wardha.
O. okeni Ag. ex Gom	Yeotmal, Khamgaon.
O. ornata Kuetz, ex Gom. v. crassa	Wardha, Chandrapur,
C. B. Rao.	****
O. princeps Vauch	Wardha.
O. proboscoidea Gom	Wardha, Satnavri.
VIVIAZZONEN	Tiroda.
O. pseudogeminata G. Schmid f. longa Kamat,	Satnavri, Akola, Tiroda.
O. quadripunctulata Bruhl et Biswas	Sakoli.
O. quadripunctulata Bruhl et Biswas v. unigranulata R. N. Singh.	Satnavri, Umred.
O. rubescens D. C. ex Gomont	Amravati, Umred, Akola.
O. raciforskii Wolosz.	Bhandara.
O. schultzii Lemm. v. cylindrica Kamat.	Wardha, Chandrapur.
O. simpliciassima Gom	Tumsar.
O. splendiad Grev. ex Gom.	Satnavri, Sakoli, Tiroda.
O. splendiad Grev. ex Gora. v. attenuata West et West.	Vena Dam.
O. subuliformis Kuetz. ex Gom	Lonar,
O. tambi Moron	Amravati.
O. tenuis Ag. v. tergestina Rabenh	Yeotmal.
O. ulrichii Prat	Gondia.
Phormidium corium (Ag.) Gom.	Amravati.
P. crossbyanum Tild.	Tiroda.
P. foveolarum Gom	Chandrapur.
P. frigidum Fritsch	Amravati.
P. jenkelianum G. Schmid	Satnavri.
P. molle Gom	Amravati.
P. mucicola Huber-Pest, et Naumann	Tiroda, Bhandara.
P. stagnina C. B. Rao	Chandrapur, Wardha.
Lyngbya allorgei Fremy v. granulata Kamat.	Satnavri.

Name	Locality			
L. birgei G. M. Smith	Tumsar.			
L. confervoides Ag	Wardha.			
L. endophytica Elenk. et Hollerb	Umred.			
L. gandhii Kamat	Amravati.			
L. hieronymusii Lemm	Umred.			
L. holsatica Lemm	Wardha.			
L. lachneri (Zimm.) Geitler v. minor Geitler.	Tiroda.			
L. limnetica Lemm	Tiroda.			
L. majuscula Harvey ex Gomont	Satnavri.			
L. martensiana Menegh. ex Gomont	Chandrapur.			
L. shackletoni West et West	Tiroda.			
L. spiralis Geitler	Satnavri.			
Microcoleus chthonoplastes Thuret ex Gomont.	Sakeli.			
Anabaenopsis arnoldii Apte. v. indica Ramnathan.	Lonar.			
A. circularis (G. S. West) Wolosz. et Miller.	Mehkar.			
A. raciforskii Wolosz	Gondia.			
Raphidiopsis mediterranea Skuja	Mansar, Katol.			
Cylindrospermum licheniforme Kuetz, ex Born, et Flah.	Amravati.			
C. majus Kuetzing ex Born. et Flah	Amravati.			
C. muscicola Kuetz. ex Born. et Flah.	Bhandara.			
C. stagnale (Kuetz.) Born. et Flah.	Amravati, Tiroda.			
Anabaena fuellebornii Schmidle	Tumsar.			
.Aineagualis (Kuetz.) Born. et Flah.	Umred.			
A. orientalis Dixit	Tumsar.			
A. sphaerica Born. et Flah	Mehkar.			
A. volzii Lemm	Amravati, Wardha.			
Nodularia spumigena Mertens	Lonar.			
Nostoc microscopicum Carm. ex Born. et Flah.	Bhandara.			
N. paludosum Kuetz. ex Born. et Flah.	Umred, Bhandara.			
N. rivulare Kuetz. ex Born, et Flah.	Sakoli.			
Aulosira fertilissima Ghose v. tenuis C. B. Rao.	Amravati, Akola.			
A. implexa Born. et Flah. v. crassa Dixit.	Amravati, Chandrapur.			
Camptylonemopsis pulneyensis Desik.	Tumsar.			
Scytonema chiaetum Geitler	Amravati.			
S. cookei W. et G. S. West	Amravati.			

Name		Locality		
S. simplex Bharadw.			Tiroda.	
5				

Fortiea bossei (Fremy) Desik. Amravati. Calothrix clavatoides Ghose Akola.

C. siphytica West et West ... Tumsar,

C. karnatakensis Gonz. et Kamat Amrayati. v. major Gonz, et Kamat.

C. marchica Lemm. . . Bhandara.

C. wembaerensis Hieron et Schmidle Tumsar. Amravati.

Dichothrix orsiniana (Kuetz.) Born. et Flah.

Gloeotrichia intermedia (Lemm.) Geitler v. kanwanensis C. B. Rao.

Chandrapur, Bhandara,

G. natans Rabenh. ex Born. et Flah. Sakoli.

G. pilgeri Schmidle ... Bhandara, Mansar, Amravati.

G. raciborskii Wolosz. Sakoli.

G. raciborskii Wolosz. kashiense ... Amravati.

C. B. Rao.

apalosiphon baronii West et West ... Mansar.

H. hibernicus West et West Mansar.



SECTION B-FUNGI

1. GENERAL INTRODUCTION:

Fungi constitute the second important group of Thallophyta. They do not have much differentiation of parts and are unicellular or multicellular, simple or filamentous, uninucleated but often coenocytic, with or without septa. Their vegetative system is very simple, but the reproductive system is not so; it is often complex. They mainly reproduce by spores produced in a variety of spore-producing organs. Some have different kinds of spores also.

They are a very ancient group of plants. They can live and thrive in water, under snow, in soil, in air, and can live even on mineral nutrition obtained from hard early rocks. There is no place where they are not to be found. Even some of the spores photographed from exosphere appear to be the spores of Fungi found in the meteorites. The constituents of some meteorites when analysed contained some amino acids found in the living organisms on earth. They thus appear to be the most ancient organisms. On young earth and in primaeval seas, they are supposed to have lived heterotrophically. It was not until chloroplasts developed in some organisms that they got intruded in them and started living with them, almost symbiotically if not parasitically, before the plants came into being. There is another view of certain scientists like Martin (1950), Schoop etc. Martin (1950) thinks that Fungi have been derived from animals, or at any rate from organisms which were omnivorous and parasitised on them in early eras. The organisms which developed chlorophyll became plants and which did not became Fungi. For want of chlorophyll they had no power of photosynthesis.

सत्यमव जयत

The total number of Fungi in the world is very large, practically onehalf of the species of plant kingdom, and as many as flowering plants. Since they evolved from Proterozoic times, they got variously differentiated into many forms; and being prolific in reproduction, multiplied and spread all over the world in course of time. Some of them disappeared in competition for existence but others survived. For example, we find fungal mycelia in the earliest Vascular plants—the Rhyniaceae of the Devonian period. In the process, since some types could not compete with others, the more aggressive and virulent types survived. They multiplied enormously in the carboniferous period. They were mostly Phycomycetes. From the Triassic period we come across higher fungi and the Imperfect fungi, which got associated with the roots of the then prevalent vegetation of conifers and lived symbiotically as mycorrhiza, and others perhaps lived parasitically. It was during the latter part of the Mesozoic period, especially during the Cretaceous period that they developed numerous types which got associated with the higher plants like gymnosperms and flowering plants which had evolved suddenly. They found new hosts and habitats in flowering plants. According to Leppik (1955), and Pirozinsky and others the evolution of flowering plants and higher fungi like rusts and smuts synchronized with the evolution of the flowering plants, but the maximum differentiation of higher fun is of later origin. Leppik (1955) has shown (Table No. II.7) development of the specialization of some main groups of Rust I u

Sorosporeae (former Melampsoraceae on Abitinaeceae), Pucciniceae and Gymnosporangiaceae have evolved side by side historically.

TABLE No. II·7

Historical development of the specialization of some main groups of rust fungi.
Sorosporeae (former on Abietaceae), Pucciniceae and Gymnosporangiaceae

Era	Stages of development	Sorosporcae on woodland plants	Pucciniaceae on grassland plants	Gymno- sporan- giaceae on mountain plants	Time elapsed in millions of years
(1)	(2)	(3)	(4)	(5)	(6)
Cenozoic	Rostelioid	Higher Ang	iosperms Glumiflorae	Pomaceae	60
Mesozoic	Telioid Aecioid	Abietaceae Ancient	Ranales Coniferous	Cup- ressaceae. Rusts	200
Paleozoic	Uredinioid Probasidioid.	Ancient	Fern Auriculariles	Rusts	300

(After Leppik 1955, p. 157).

They attacked any wild plants which provided them with suitable nutrition. They evolved several metabolic processes and nutritional mechanisms, and physiologic races. The fungi thus today are the largest group of plants in water, soil, air, on other plant groups, crops and forest trees, animals, insects, etc. Even man has not escaped their attack. It is essential, therefore, that everyone should have some knowledge of Fungi. The following pages describe some plant diseases in Maharashtra and their causal organisms. There are many books on plant diseases and their control and it is not intended to repeat them here.

2. Brief History of Studies on Fungi in Maharashtra:

In Maharashtra the tradition of studying and describing fungi and diseases is very old and perhaps the oldest in the country. Study of mycology in the State dates as far back as 1886 when Kirtikar described Agaricus astreatus, growing on Artocarpus integrifolia Linn. It was thought by Dymock (1886) to be a Polyporus, but on re-examination it turned out to be Agaricus renamed as Boletus nitens-artocarpalis Kirtikar. But even that name is no longer valid. Kirtikar wanted to publish a monograph on fungi of Bombay on the material he had collected and that collected by Justice Birdwood of the Bombay High Court; but it never materialised. Dalgapto (1898) while describing the Flora of Goa and Sawantwadi, included the Fungi in it. By 1904 Father Ethelbert Blatter S. J. had come to India and started teaching Biology with the help of local plants and animals at the St. Xaviers College, Bombay. He himself

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published in 1911, in Journal of the Bombay Natural History Society Vol. 21, pages 146-152 a list of about fifty higher fungi, from a German paper based on the material he had collected and identified by Theissen (1911); later Theissen (1911) himself published a more comprehensive paper in Journal of the Bombay Natural History Society, Volume 21, pages 1274 -1403 on the Fungi of Bombay. By that time the College of Agriculture at Pune was organised as a college separated from the then College of Science located in what is at present the College of Engineering. Mycology and Plant Pathology laboratory was organized in College of Agriculture, Pune and this gave a great incentive to the study of Fungi and plant pathology. In 1911, Chibber (1911) issued a working list in diseases and vegetables pests of some economic plants occurring in Bombay Presidency, which was enlarged by him in 1914 as Bulletin No. 65 of the Department of Agriculture, Government of Bombay. In the meantime early in the beginning of 1914 during the World War I, Professor S. L. Ajrekar, B. A. Cantab, I. E. S., joined the College of Agriculture as Professor of Mycology and Plant pathology at the Agricultural College, Pune, and was assisted by Kulkarni, Kamat, etc. They studied Jowar smut and the downy mildew on bajra and jowar. Then came Uppal who jointly with Patel and Kamat published in 1935 a consolidated list of the Fungi of Bombay as Bulletin No. 176 of the Department of Agriculture, Bombay. This list contained 593 Fungi belonging to all groups and a short account of viral and other diseases. This was amended by Patel, Kamat and Bhide (1949) who included several new fungi described by later workers. Very recently a much more comprehensive list of Fungi of Maharashtra comprising so many new genera and species has been compiled jointly by Kamat, Patwardhan, Rao and Sathe (1974). It is published by the Mahatma Phule Krishi Vidyapeeth of Rahuri as Bulletin 1. This contains a fairly upto-date list of Fungi in Maharashtra including those of Berar, Nagpur and Marathwada. It consists of 1,269 species belonging to 346 genera, including two genera of Sterile mycelia, two of Myxomycetes, 31 of Phycomycetes, 86 of Ascomycetes, 97 of Basidiomycetes and 140 of Fungi Imperfecti which forms the largest group. This number is fairly comparable with the list given by Butler and Bisby (1918) which gives 2351 Fungi of India, some new additions were supplemented later by Mundkur (1934) and again in a second supplement by Tilak and Rao (1965). This makes a huge addition to the Fungi of India including Maharashtra. There is a great spurt today for the work on Mycology all over India. Numerous workers in Maharashtra and elsewhere like Tilak, Patil, Payak, Raiderkar, Deshpande, Chiddarwar Rao, Sathe, Vaidya, etc. who have added Excellent works on their morphology, symptoms, life history, to them. cytology, control measures are given in these works on Mycology and Plant Pathology and the reader is referred to them for further information. Only important pathogenic fungi on plants, especially those causing serious diseases to economic plants like crops, fruits, vegetables, forest trees and man are given here. They do not claim to be exhaustive and have been briefly treated.

The list of fungi of erstwhile Bombay State enlisted by Uppal, Patel and Kamat in 1935 were subsequently revised by Patel, Kamat and Bhide in 1949, covering fungi of the whole region falling under Bombay Presidency. After the separation of Sindh, Gujarat and Karnatak, it was necessary to revise and relist the fungi occurring in Maharashtra State as now constituted. This list has been published in 1971 as a Bulletin No. 1 of Mahatma Phule Krishi Vidyapeeth, Rahuri, written by M. N. Kamat, P. G. Patwardhan, V. G. Rao, A. V. Sathe of the Mycology Department of Maharashtra Association for the Cultivation of Science,

Pune. It gives the fungi listed earlier, and those added by later authors who have made substantial additions since 1953. Not less than 6 new genera and 300 species have been added. The total number of species of fungi in Maharashtra now comes to 92 Phycomyceats, 206 Ascomycetes, 280 Basidiomycetes and 703 Fungi imperfecti. The important among these are species of Alternaria, Cercospora, Elsinoe, Erysiphae, Synchytrium Parodiella, Phyllachora, Phyllosticta, Physoderma, Septoria, Synchytrium, Black spot fungi and rust fungi and many leaf litter fungi belonging to Hyphomycetes investigated by S. D. Patil and Kamat, Patwardhan, Rao and Sathe (1971).

Some strange observations regarding them deserve mention here. genus Parodiella is unusually confirmed in this State to legumes. black or dark spot genus *Phyllachora* has a wide variety of hosts both, dicot and moncot. In monocots they are mostly found at low altitude, but on dicots they occur at high altitude 2000 -4000'. The perithecial stages of Powdery mildews are found generally in winter months—November to February. A hyper-parasite Ampelomyces is also found on Erysiphopsis in rainy season—August-September and is confined only to Acalypha species. Some new genera such as Narasimhella, kamatomyces, Chlamydorubra, Cyclodeomella, Mahabalella, Tawdiella, Volutellospora, belonging to Imperfect fungi were newly noted. flora of Maharashtra appears to be very rich in Fungi Imperfecti. Diseases of fruits and vegetables human pathogens have been reported by Hindustan Antibiotics Ltd., Pimpri and new fungi giving antibiotics. They also have been included here. A large fungal reference collection has been built at Maharashtra Association for Cultivation of Science, Pune since 1953, and it is deposited in the Ajrekar Herbarium which is now internationally recognised for depositing fungal type specimens.

3. CLASSIFICATION OF FUNGI:

Classification of fungi is based mainly on the presence or absence of reproductive bodies, but some of them do not have them or show them. They are generally put under 'Imperfect Fungi', many of which cause serious plant diseases on wild and cultivated plants.

It should always be remembered that every fungus anywhere, even on wild plants is a potential pathogen. The classification here, therefore, merely indicates the accepted taxonomic system followed by mycologists in general.

- (1) Myxomycetes.—These are slime mold fungi having two sub-classes and seven Orders depending upon the presence or absence of peridium. They are not pathologically important except Club-root of Crucifers caused by Plasmodiophora.
- (2) Phycomycetes or Algal fungi.—They are a well knit group. They have three sub-classes and 10 Orders and 24 families. They cause some serious diseases of fruits, vegetables, and even of man. Pythium, Monoblepharis, Physoderma are typical examples of them. Diseases caused by them on economic plants are given in List 2. They have motile gametes and two laterally ciliated zoo-spores and variously shaped conidia. Sporangium formation is the usual method of reproduction. They however reproduce sexually when their + and strains are grown together.
- (3) Ascomycetes.—This group is very important pathologically. They are quite complex compared to lower fungi and reproduce by the formation of various bodies called ascocarps which produce asci having endogenously formed ascospores. They live as saprophytes and parasites on a

variety of plants, in soil, in water, etc. Aspergillus, Penicillium are specially important. They form Molds, Powdery and Sooty mildews. Brown rot, scab in important crop plants like bajra etc. They form Ergot of Rye. Importance of *Penicillium* need not be told since its species P. chrysogenum and P. notatum are the source of well-known antibiotic 'Penicillin'. There are various species of Aspergillus which are added to alcohol for flavour. Ascomycetes reproduce by two phases, conidial or asexual phase, and Ascigerous phase producing asci. It is the sexual reproductive phase of the plant. Sexual process and diplodisation are quite complex processes. Formation of fruit bodies or ascocarp is common. They have 2 sub-classes, 15 Orders and 36 families. Some of these fungi are highly destructive, but some of them are quite useful and yield important drugs and auxins, particularly Claviceps purpurea which gives Ergotine, Gibberella gives the well-known auxins Giberellins. The diseases caused. by them are listed in Table II-8.

(4) Basidiomycetes.—This group includes more than 25,000 species It is highly advanced and forms exogenously basidisopores usually 2-4 rarely 8, produced on basidia. Some of the diseases caused by them on jowar, bajra, onion, figs, grapes are very destructive. The largest number of plant diseases are caused by them. They reproduce both asexually and sexually also by formation of spermatia, uredia and other type of spores by the process of diplodisation and somatogamy. Their taxonomy is based on the form of basidium. Rust of wheat and other plants, and smuts caused by them are typical examples. There are two subclasses, 2 Orders and 27 families. Ustilago, Mundkurella, Tilletia, Uromyces, various rusts, smuts and bunts are some examples.

Over a thousand species of smuts belonging to Ustilaginales and over 40 rusts (Uredinales) are known. Rust reproduce by the formation of different spores, sometimes on the same plant and some times on a different plant serving as an alternate host. They cause great damage to wheat crop, coffee, etc. They show heterothallism. They have various physiological races of which about 11 occur in India. The testing of wheat strains for resistance and pathogenacity on a particular strain of wheat rust is done at Mahabaleshwar at the Regional Wheat Rust Research Station. Account of it is given separately.

- (5) Fungi Imperfecti.—These are a provisional group, which reproduce by vegetative reproduction forming conidia. Their sexual or perfect stage is not known in most cases. Examples are Cercospora on groundnut, wilt caused by Fusarium in cotton, pigeon pea etc. They are of considerable economic importance. Their classification is artificial depending upon the acervuli, pycnidia, synnemata and on conidia—whether 1-celled or 2-celled, and whether they are globular, cylindrical, ovoid or oblong. Some times the conidia are hyaline or may be coloured, smooth or muri formed. They cause wilt of cotton and other plants, diseases on pineapple, and red-rot of sugarcane etc. They have 4 Orders and 9 families. They are associated with forest trees and grasses as mycorrhiza.
- (6) Mycelia Sterilia.—Mycelia sterilia is the last group of fungi. It has not been well studied, and full details are not available. They are sterile but cause a few diseases of plants.

4. MYCOLOGY AND PLANT PATHOLOGY

The study of fungi forms the subject matter of mycology. It has both fundamental and applied aspects. The fundamental aspects deal with the

major theoretical problems of classification, taxonomy, life cycles, reproduction, cytology, genetics etc., irrespective of the utility of the information gathered. It provides continuously new streams of ideas and materials to the workers for research; whereas the applied mycology deals with the information gathered as applied to a particular problem or a topic under consideration. Its scope, therefore, is necessarily limited and has particular aim in view to achieve. Since fungi are universal, their control also has to be universalised. The main fields of application to human affairs are Agriculture, Horticulture, Industry, Food, Medicine, Forestry, Water, Hygiene. The fungal spores being small and light are always floating in air and affect man, and other animals who inhale them. They settle on crops and often cause diseases both to crops, animals Therefore, special precaution has to be taken against the incidence and spread of fungal spores causing asthema and other lung disea-The fungal spores settle on any moist surface anywhere and viciate it. So precautions have to be taken that they do not break out in huge numbers causing epidemic. Study of all plant diseases and their control is the subject matter of Plant Pathology.

5. WORLD POPULATION, FOOD AND FUNGI:

The quantity of food produced in the world is always insufficient for the numbers that live on earth. Many countries except America have to import food grains, oil seeds etc. Along with them come seed borne fungal spores from foreign lands. Every country, therefore, has to take preventive measures against them by way of 'Plant Quarantine Regulations', especially against the live materials such as fruits, vegetables bulbs, tubers etc. Generally any foreign material to be brought in the country has to be certified as free from disease or infection by the exporting country; otherwise it is detained in Plant Quarantine at the point or port of importation. Seeds and grains are generally fumigated by sulphur dioxide or dusted with fungicides, it being easy to do so, and is effective also; but with the live material it is only the surface sterilization that is achieved by this method. The causal organisms could be much deeper inside and, therefore, a certificate by the quarantine authorities of that country is required stating 'No objection' for export. Government of India also has made similar arrangement and passed Indian Plant Ouarantine Rules of 1914, amended from time to time.

Another source of importing alien pathogens is the tree saplings and vegetative slips. Very often good and high yielding fruit trees, ornamentals and other economically useful plants, for timber, fiber, paper, medicines etc. have to be imported. This is done generally at the State level or the country level by the 'Bureau of Plant Introduction' who take all care while importing a particular plant either for industry or for food, beverages, medicines and such other utility purposes and see that they do not import diseased material. There is a 'Bureau of Plant Introduction' at the Central Agricultural Research Institute at Delhi. Some material required by a scientific worker for research, brings it with him open or concealed. He unknowingly gets trapped. Material is generally confiscated and destroyed and person warned; and still the piracy of important fungi or other materials having ability for a particular chemical product or an antibiotic, or for producing epidemic goes on from country to country all over the world. It is as common as the exchange of research materials. However, the spores coming in a country through aeroflora as 'Air borne spores' can never be stopped; only preventive hygienic measures can minimise the ravages due to air borne spores. Like patented machines and processes, certain fungal spores,

their culturing and processing methods are also patented. e. g. Mucor strains which produce citric acid, Aspergillus oryzae producing 'Sake' and other wines, various strains of yeast producing high grade wines and liquors etc.

Still another source of really terrible infection introduced in the country is the small weed seeds. Many of them came with foodgrains or attached to the baggage of air passengers, and to aeroplane parts. In these days of fast air travel weed seeds also travel equally fast and spread infection from one country to another. In a new country there is less competition to them and they spread and prosper enormously. The latest and the most destructive weed in India today is *Parthenium histerophorus*, a compositae weed. Similarly the bispinous fruits of *Amarantus bispinosus* came to India during World War I from the Middle East countries with troops. The plant quarantine and plant protection rules are not enough to stop the evil of import of the weeds and fungi that come with them.

6. FUNGI CAUSING PLANT DISEASES:

Quite a large number of fungi cause diseases to plants and destroy them, or damage the yield. In this, the bacteria, fungi, viruses and insects play title role. Of all these, plants suffer most due to fungal diseases, because they damage man's crops, his food, his lumber, clothes, paper, pollute his food, and water. Therefore the important of them are described here as under and then other general topics:—

- 1. Fungal diseases of crop plants-cereals, pulses, oil seeds, spices and condiments.
- 2. Diseases of fruits in storage in market.
- 3. Bacterial diseases of fruits and vegetables.
- 4. Diseases of vegetables in storage in market.
- 5. Fungi on medicinal plants.
- 6. Fungi on ornamental plants.
- 7. Diseases of forest trees.
- 8. Bacterial plant diseases.
- 9. Viral and other diseases due to worms etc.
- 10. Wood rotting fungi.
- 11. Soil fungi.
- 12. Useful fungi; their industrial uses.
- 13. Fungal diseases of man.
- 14. Yeast and fermentation.
- 15. Antibiotics.
- 16. Food spoilage and mycotoxins, etc.

6.1 Cereals

TABLE No. II-8

Fungal Discases of Cereals in Maharashtra

Serial No.	Host	Disease	Causal organism		Pari	Parts affected	Control/Remarks
Ξ	(2)	(3)	(4)			(5)	(9)
-	RICE	**************************************					
	Oryza sativa	Blast	Piricularia oryzae	:	Seedling	:	Seeds to be treated with perenox
	Do.	Bunt (Black smut)	Neovassia horrida	Sec.	Ovaries	:	Removal of infected parts.
	Do.	Head blight (Rati)	Helminthosporium oryzae		Leaves	:	Seed treatment with perenox.
	Do.	Agarbati	Ephelis oryzae		Ear	:	Roguing of affected heads,
	Do.	False smut (Green smut) Ustilaginoidea virens	Ustilaginoidea virens		Grains	:	:
	Do.	Sclerotial disease	Sclerotium rolfsii		Plants sh	ow tillering	Plants show tillering steri- Not known.
~	Jowar				IIII OI BI	allis.	
	Sorghum vulgare	Grain smut	Sphacelotheca sorghi	:	Ovaries	:	Treat seed with sulphur (4.60)
	Do.	Leaf shred	Sclerospora sorghi	:	Leaf	:	and sow Flooding seed before sowing.
	Do.	Leaf rust	Puccinia purpurea	:	Leaf	:	Grow resistant varieties.
	Do.	Kharkharia disease or	Macrophomina phaseoli	:	Stem	:	Long rotation avoid lodging.
	Do.		Sphacelotheea graminicol	:	Ovaries	:	Not known.
	Do.	Sheet spot	Collectorichum sorghi	:			

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Trkicum aestivum									
	Black stem-rust	•	Puccinia graminis var. triticum	ar. <i>triticu</i>	:	Stem	:	:	Grow resistant varieties.
	Leaf rust		Puccinia tritici	:	:	Leaves	:	:	Grow resistant varieties.
	Foot rot	;	Fusarium sp. and Pythium gramini- cola,	rthium g	ramini-	Seedling blight	blight	:	Treat seeds with TMTD (2-60),
	Loose smut	:	Ustilago tritici	:	:	Inflorescence	agu	:	Solar heat treatment.
	Head light	:	Fusarium culmorum	:	:	Ears	:	:	Grow resistant varieties.
,	Leaf mould	:	Cladosporium herbarum	rum	9	Leaves	:	:	Store grains well drained and in cocl ventilated.
4 Bajra	Leaf rust	:	Puccinia penniseti			Leaves	:	:	Resistant varieties may be
	Pennisetum typhoides Stapf, and Hubbard.	ςpi	ामेव प्रमेव						אַנְבְּנְנְבְּנֵים.
	Green ear	:	Sclerospora graminicola	cola		Leaves	:	:	Systematic removal in early
	Smut	:	. Tolyposporium penicillariae.	illariae		Grains	:	:	Systematic removal of attacked
	Ergot	:	Claviceps microcephala	ala	:	Ear head	:	:	Obtain seed from disease free
5 MAIZE									
Zea mays	Dawny mildew	:	Sclerospora sorghi	:	:	Leaves	:	:	Systematic reducing in young
	Brown spot	:	Physoderma maydis	:	:	Leaves rodes	des	:	Long rotation.
	Seedling blight	:	Fusarium sp.	:	:	Seedling	:	:	Dry seed treatment with Nomersa or Agrosau GN (3 oza-60 lles) before seeding.

6.2. Pulses and Legumes

TABLE No. 11-9

Fungal Diseases on Pulses and Legumes in Maharashtra

Seri	Serial Name of the Host	Disease Fungi Imperect	. Causal organism	Parts affected	Control/Remarks
₹E	(2)	(3)	(4)	(5)	(9)
_	Gujanus cajan (L.) Mills.	(L.) Wilt	Fusarium oxysporum	Leaves	Very difficult to control.
7	Piascolus vulgaris L. (Beans group).	Phascolus vulgaris L. Ascomycetes powdery Erysiphae polygoni . (Beans group).	Erysiphae polygoni	Leaves	Sulphur dusting.
m	Glycine soja Merr. Downy midew (Soybsan).	;	Peronospora sp.	Leaves	Spray half grown plants with Bordeaux mixture (3-5-50) one or two times at 3 weeks interval.
4	Pium sativum	::	Uromyces fabae (Pers) de Bary Peronospora viciae Eministra alimenta	Leaves Charte Bowans	Dust crop afflowering time with fine sulphur dust (25 per acre).
	Lens esculentus Moueuch.	Dry rot	Lifsipun pusgoni. Uromyees fabae Fusarium arthoceros		
9	Cicer arientinum L Leaf	spot	Pycnidial stage Phyllostictaspp Perfect stage Mycosphagrella	Leaves	Chemical treatment.
7	Phaseolus mungo L. Any var. radiatus Black	Any part		:	:
	gram. Fhaseolus mungo L.	Leaf spot Powdery mildew	Cercospora canescens Erysipha polygoni	Leaves	: :
œ	Phaseolus mungo	Powdery nildew	. Erysiphe polygoni	Leaves	Dusting plants with 300 mesh sulphur early.
6	Dolichos lablab L Powdery mildew	:	Ovulariopsis macrospora Colletotrichum lindemithianum	Leaves, sleari etc.	Airborne spraying of Bordeaux mixture.

6.3. OILSEED PLANTS TABLE NO. II-10

Fungal Dispass on Ollsbed Plants in Maharashtra

Distribution Control Remarks (6) (7)	htra Grow early maturing foreign varieties, avoid local varieties.	. Proper fungicide-Daconil.	. Systematic rogueing.	n. Growing resistant varièties.	Spray plants with Bordeaux mixtures (3-3-50).	Airborn.	. Controlling chemical, treatment.	Spray Bordeaux mixture (3-3-50).	:	altivated
Distr	Maharashtra	Do.	Do.	: Do	: Do.	Do.	. Do.	. Do.	Do.	Rarely cultivated
Parts affected (5)	Leaves	Leaves	Plants	Adult plant	Leaves	Leaves	Cotyledones Young leaves.	Leaves	Leaves	Leaves
Causal organism (4)	Cercospora arachidicola	Puccinia arachidicola	Sclerotium rolfsii	Fusarium lini	Melamspora ricini	Cercospora sesami	Puccinia carthami	Puccinia helianthi	Alternaria tenuis	Peronospora adelocaryia
Disease (3)	. Tikka	Rust	Root rot	Wilt	. Rust	. Leaf spot	Rust	Rust	. Leaf spot	:
Name of the Host (2)	Arachis hypogea L. (Groundnut).			Lium usitatissimum L. (Linseed) (Jawas, Alshi).	Rivinus communis L. (Castor Oil).	Sessmum indicum DC	Carhamus tinctorius L. (Safflower).	Helianthus annuus L. (Sunflower).	Guizotia abyssinica	Papavar somniferum L. (Poppy or Aphi aphu).
Serial No.	-			7	ю	4	5	9	7	∞

6.4. SPICES AND CONLIMENTS

Distribution 9 Fungal Diseases on spices and Condiments giving Plants Parts affected (5) TABLE No. 11-11 Causal organism 4 Discase \odot Name of the Host

Control/Remarks 6

:	:			
	Maharashtra	Maharashtra.		
Leaf.	Leaf	Young leaves	Leaves.	Leaves.
Leaf spot Rhizome Taphrina maculans and Root rot. Colletor richum capsici.	Powdery mildew Alternaria burnsii blight.	Fusarium oxysporum	Mildew blight Laveillula teurica Cerco-spora foeniculi.	Leaf and fruit Scelrotium rolfsii Diplodia, blight, Alternaria sp. virus and other diseases.
1 Curcuma longa L	Cuminum cyminium L.		Foeviculum vulgare	Capsicun annum
1	CΙ		O	7 }

3

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6.5. FRUIT TREES

TABLE No. II-12

Fungi Causing Diseases of Fruit Trees

Name		Causal organism	Part affected
(1)	J	(2)	(3)
Cucurbit maxima		Pseudoperonospora cubensis	Leaf.
Citrus sinensis		Phytophthora palmiyora Butler	Stem, fruit leaves.
		Meliola citricola Syd	Leaves.
		Diplodia indica Died	Bark.
Citrus sp		Rhynchodiplodia citri Briosi and Farnetti.	Fruits,
Citrus chinensis		Collectorichum gloeosporioides Pensig.	Leaves, twigs.
Vitis vinifera L		Plasmopara viticola Bark and Curt.	Leaves and fruits.
		Diaporthe viticola Nitis	Leaves and fruits.
		Eutypella vitis Ell, and Ev	Wood of wine.
		Gloeosporium ampelophagum Sacc.	Stem, leave, berries
Carica pa p ay a		Pythium aphanidermatum Fitzpatrics.	Roots and fruits.
		Diplodia papayae Theum.	
		Macrophomina sp.	
		Rhizoctonia bataticola Ashby.	
		Gloeosporium papayae P. Heun.	Fruits.
Eugenia jambulana L.		Capnodium eugenianum	Leaves.
Cucumis sativum L. (Kakadi).	••	Erysiphe polygoni DC	
Psidium guyava L		Meliola psidi Fr	Leaves.
		Physalospora psidii Stev and Peir Uromyces fabae De Bary.	Fruit, Leaves.
Mangifera indica L		Meliola mangifera Earle	Leaves.
		Polyporus persooni Fr	Stem.
		Patou. Mill. Bagnisiella mangifera Tilak and	Twigs.
		R. Rao. Phyllosticta mortani Fair	Leaves.
		Gloeosporium raciboiskii	Fruits.
		P. Henn. Pestalotia funeria des	Leaves.
		Var. mangiferae Sacc. Rhinocladium corticolum	Bark.

BOTANY AND FLORA

TABLE No. II-II-contd.

Name	Causal organism	Part affected
(1)	(2)	(3)
Fragaria vesca L	Mycosphaerella fragaroae (Ful) Lind.	Leaves.
Aresa catechu L	Xylaria plebeja Cesati	Roots.
	Colletotrichum catechu Diedicac.	
Cordia rothia Rosm and Schutt.	Aecidum brasiliensa Dief Septoria cordiae Syd	Leaves. Leaves.
	Uromyces setariae-italica	Leaves,
Elaegnus latifolia	Accidium elaegnilati foliae Patch	Lcaves.
	Endophyllum elaeagnitati-foliae	
Zizypus rugosu Lam. (Ber)	Crossospora zizyphi Syd	Leaves.
	Oldium sp. Cladusporium zizyphi Carst.	
Coffea arabica L	Hemileia vestatrix Berk, and Broome.	Leaves.
Gardeniu gumwifera L	Haplosporella gardeniae Stems.	Leaves.
Ricinus communis L	Melamspora ricini Pers	Leaves.
Phyllanthus emblica L	Phakopsora phyllanthi Diet and Syd.	Leaves.
Vigana catjang Walp	Uromyces appendiculatus (Pers.) Linn.	Leaves.
	Corticium soloni Vourdotty and Galgin	
Gossypium *p	Diplodia gossypina Diplodia manihotia Sacc	Old capsules. Fruits and seeds.
Cymopsis tetrugonoloba L	Phoma sp.	
Artocarpus heterophyllus Lam	Phyllosticta artocarpina	Leaves.
Mimusaps hexundra Roxb,	Robillarda scutata Syd	Leaves.
Pyrus malus L	Scopella gentilis	Leaves.
	Microsporium sp.	
Musa sopientum L	Pestalotia leprogena Speg.	
	Cladosporium sp.	
	Fusarium oxysoprum Schul.	
Citrulius vulgaris L. Melo	Sclerotium rolfsii Sacc.	

6.6. Diseases of Fruits in Storage

TABLE No. 11-13

Fungi Causing Diseases of Fiuits in Storage in Market

Name	Disease	Causal organism
(1)	(2)	(3)
Annonaccae		
Annona squamosa L. (Sitaphal).	Phytophthora rot	Phytophthora parasitica Dast Var. macrospora Ashby.
	Black rot	Botryodiplodia theobromae Pat
	Charcoal rot	Macrophomina phaseoli (Maubl. Ashby.
	Anthracnose	Coll totrichum gloeosporioide
	Black spot	Peng. Pestalotia bicolor Ell. and Ev
Annona reticulata L	Black rot	Botryodiplodia theobromae Pat
(Ramphal).	Rhizopus rot	Rhizopus nigricans Ehrenb.
	Anthracnose	Colletotrichum gleosporioides
Garcinia indica choiss. D. C. (Ratamba).		Peng. Pestalotia espellatii.
Tiliaceae Grewia asiatica L. (Phalsa)	(Mark)	Uredopeltis grewiae.
Oxalidaceae Averhoa carambola L (Karmak).	Aspergillus rot	Aspergillus niger Vantieh.
Citrus medica L. (Limbu) acida.	Citrus canker	Xanthomonas citri (Hasse). Dowson and Dowson.
	Waxy rot	Geotricum candidum Link.
·	Leaf fall and fruit	Phytophthora palmivora Butle
Citrus sinensis	rot. Osbeck fruit rot	Gloeo: porium citri Mass.
(Musambi).	Black rot	Alternaria citri Pierac.
Citrus paradisi Macf. (grape fruit). Papas.	Decay	Gloeosporium citri and Geotrichum candidum.
Citrus reticulata Blanco	Decay	Penicillium italicum Wehmer digitatum Sacc.
Feronia limonia Swingle (Wood-apple)	Diplodiadry rot	Diplodia natalensis Evans.
	Pink rot	Trichothecium roseum Link.
Aegle marmelos Corr (Belphal).		
Burseraccae Garuga pinnata Roxb. (Kakad).		
Rhamnaceae Zizyphus guruba Lamk. (Bor).	Fusarium wilt	Fusarium roseum Link.

TABLE No. II-13—contd.

Name	Disease	Causal organism
(1)	(2)	(3)
Vitaceae Vitis vinifera L. (grape)	Anthracnose	Gloeosporium ampelophagum de Bary Socc.
	Cladosporium rot	Clodosporium herbarum Link.
	Powdery mildew	Uncinula necator (Schw.) Burr. (Schw.) Burr.
Sapindaceae Nephalium longana Comp. Woomb.		
Litchi chinensis Sonn	Black rot	Aspergillus niger var. Tieghi.
(Litchi).	Fruit rot	Botryodiplodia theobromae Pat.
Anacardiaceae Rhus mysurensis Heyne (Ambat).	- THE S	
Mangifera indica (L) Mango	Sooty mould Black spot.	Capnodium ramosum, Actinodochium jenkinsii Upptal, Patel and Kamat.
	Black rot	Asperigillus niger Van Tiegh.
	Botryodiplodia rot	Botryodiplodia theobromae.
	Ripe rot	Colletotrichum gloeosporioides Peng.
	Cladosporium rot	Cladosporium herbarum (Pars.) Link.
	Corky spot	Rhizopus nigricans Ehr.
	Anthracnose	Colletotrichum glocosporioides Pengig.
Annacardium oxidentale L. (Kaju).	Fusariial rot	Fusarium oxysporum Scht. ex. Fr.
-emicarpus anacardium (Biba).		
Spondia mangifera Willa (Ambada).		
Rosaceae		
Pyrus matus L. (apple)	Scab	Fusicladium deniriticum (Wallr.) Fuckel.
	Soft rot	Rhizopus nigricans Ehr.
	Canker	Sphaeropsis malorum Pk.
Prunus armeniaca L	Soft rot	Rhizopus nigricans Ehr.
(apricot).	Black rot	Memnoniella echinata (Riv.) Gallow.
Ribes grossularia L. (Gooseberry).	Scurf	Alternaria tenuis. Geotrichum candidum Link.

TABLE No. 11-13-contd.

Name	Disease	Causal organism
(1)	(2)	(3)
Rubus sp. (Raspberry)	Soft decay	Rhizopus nigricans Ehr.
Prunus persica Sandz. (Peach).	Leaf curl	Taphrina deformans Berk and Tulh.
	Powdery mildew	Sphaerotheca pannosa (Wallr.) Lev.
Prunus domestica (L) (Plum)	Waxy rot	Geotrichum candidum Link.
Fragaria vesca (Strawberry)	Leaf spot	Septoria aciculosa Ell. and Ev.
Myrtaceae Psidium guava L	Phytophora rot	Phytophthora parasitica Dastur.
	Anthracnose	Colletotrichum psidii.
	Pink rot	Trichothecium roseum Link.
	Fruit canker	Pestalotia psidii Pat.
	Phoma rot	Phoma psidii P. Henn, Delacr
	Ripe rot	Gloeosporium psidii Delacr.
	Waxy rot	Geotrichum candidum Link.
Eugenia corymbosa	YAYNAT	Species of several fungi like Pestalotia, Ciliochorella,
E. jambolana (Jambul)		Meliola, etc.
E. malakensis E. jambos		Capnodium eugenianum.
Punicaceae Punica granatum L (Dalimba).	Phomopsis Rot	Phomopsis versoniana Sacc.
(Black Rot	Asperigillus niger v. Tiegh.
	Bacterial leaf Spot	Xanthomonas punicae. Hingorani and Singh.
Onagraceae Trapa bispinosa Roxb. (Shingada). (Caricaceae). Passifloraceae (Cariaceae)		•
Carica papaya L (Papaya).	Ripe Rot Phoma Rot Soft Rot	Gloeosporium papayae P. Henn. Phoma caricae Papayae A lasch. Pythium aphanidermatum (Eds) Figs.
Cucumis melo L (Kharbus).	Phoma Rot	Phoma citrullicola Sawada.
(Kuai vuo).	Charcoal Rot	Macrophomina phaseoli (Maubl). Ashby.
	Bitter core Rot	Trichothecium oseum Link.
	Pythium Rot	Pythiuma aphanidermatum (Edson) Fitg.
Citrullus vulgaris	Curvularia Rot	Curvularia lunata (Warker) Boedijn.
Scjr (Terbuse) or Water melon		Poemin.

BOTANY AND FLORA

TABLE No. 11-13-contd.

Name	Disease		Causal organism
(1)	(2)		(3)
Trichosanthes palmata Roxb	Charcoal Rot		Macrophomina phaseoli (Maubl. Ashby.
Kalingad	Dry Rot Pink Rot	••	Bortyodiplodia t' cobromae Pat Trichothecium roseum Link.
Rubiaceae Vanguria spinosa V engueria roxberow Sapotacyae			
Achras sapota L (Chikoo)	Soft Rot Sooty mould Leaf spots		Rhizopus r igr icans Ehrenb, Capnodium sp. Phytopthora palmivora.
Bassia latifolia Roxb.	Fusarial Rot		Fusarium incarnatum (Roberge Sacc.
Oleaceae	~ F	1	
Olea europaca L. (Olive)	Peacock eye	spot	Cyclonium oleaginum Cal.
Euphorbiaceae		1265	7
Phylanthus emblica L (Avla).	Fruit blemish		Ravenelia emblicae Sydow.
Phylanthus distichus Muell (Rai Avala).	1/1/1	77	
Urticaceae	The same of the sa	15	7
Ficus carica L. (Fig)	Rhizopus Rot Mosaic disease		Rhizopus nigricans Ehr. a virus
Artocarpus heterophyllus L (Jack fruit or Phanas)	Leaf spot	••	Colletotrichum lagenarium (Pers) Ell and Holst.
	Stem Rot		Phytophthora palmivara Butler.
	Brown Rot		Fomes noxius Conner.
Artocarpus incisa L (Bread fruit).	Black Rot	• •	Botryodiplodia theobromae Pa
Musaceae			
Musa paradisiaca L	Black Rot	••	Gloeosporium musarum Cke.
(Banana).	Fusarium Rot		Fusarium roseum Link.
Bromaliaceae			
Annas comosus Merr (Pine apple)	Black Rot	••	Theilaviopsis paradoxa V. Hoehnel.
Palmaccae			
Areca catechu L	Blemish disease	e	Theilaviopsis paradoxa V. Hoehnel.

7. BACTERIAL DISEASES OF FRUITS AND VEGETABLES

TALE No. II-:4

Bacterial Diseases of Fruits and Leafy Veget; bles

Name of the Plant (1)	Disease (2)	Casual organism Co	Control and Remarks (4)
Saccharum officinarum L	. Red stipe of sugarcane	Xanthomonas rubrilianeans (Lee, et al) Burning diseased plants and building Starrand Burkh holder.	urning diseased plants and building resistant variety.
Gossypium Sp Solanum tuberosum L	Seedling blight angular leaf spot and black arm of cotton Brown rot of	Xanthomonas malvacearum (Dowson) Building resistant varietics. E. F. Smith. Erwinia caroto vora (Jones) Holland Destruction of diseased tu	Building resistant varieties. Destruction of diseased tubers and putting them in chlorinated water.
Hibixeus escuientums Allium sativum L	. Leaf spot of Bhendi or Okra Seedling blight on onion	Xanthomonas esculanti Rangaswami Roots are also affected by worms, and Easwaran. Pseudomonas sicctum (Moniz and Poetel) Rangaswami	are also affected by worms.
Lycopersicum esculentum Mil Capsicum annum L.	Mill and Leafspot of tomato and chillies	toria	(Doibge) 300 to 500 p. of Streptomycin spray 3 to 5 times.
All Crucifers	Black rot of Crucifers	Xanthomonas campestris (Pammel) 1 pp. o	(Pammel) 1 pp. of mercuric chleride for 30 minutes effective.
Soft rot of vegetables, roots crops	·· ·· ·· pue sdo	Eyrwinia carotovora (Johns) Holand Wound	Wounding to be avoided.
bulos. Amaranihas viridis L	Leaf spot of Amaranthus	Xanthomonas amaranthicola Patel et al.	;
Cuum is sativas L. Cucumber	r Leaf spot of cucumber	Xanthomonas cucurbitae (Brayan) It also affectorson. C. maxim C. moschu C. sativus.	(Brayan) It also affects other cucurbitae C. maxima. C. peto. C. moschata, C. vulgaris. C. sativus.

TABLE No. II-14-contd.

(3) (4)	A Speces of Bacturium Xanthomonas phaseoli (E. F. sm.) Common on Pea, Pisum vulgaris. Dowson. Xanthomonas cassiae Kulkarni et al. This is being seed borne disinfection of seed is essential. Xanthomonas vigni co.a Burk holders.	Xanthomonas cyamopsidis Patel et al. Xanthomonas eajoni Kulkarni et al.	Xanthomonas plaseoli soje se (Hedges Dusting seed with sulphur. Dowsen). Xanthomonas ricini cola (Elliott) Dowson. Serdomonas detle (Raghunathan) Bergis et al. Xanthomonas alfa alfae (Riber et al.) This bacterium can affect several other leafy legumes, plants such as Pisum sativum Trigonella, Foenum grae cum. Xanthomonas citri (Hasse) Dowson.	Pseudomonas mangiferae indicae Patel It also affects fruits. et. al. Xanthomonas jasmini Rangaswami and Eswaran. Xanthomonas compestris (Pamm.) Pruming affecte 1 branches, and spray Dows.	Xanthomonas oryzae New antibiotic Streptocyclene 0.3 gms in 100 lits twice or thrice should be sprayed.
(2)	Schott. Leaf spot of Colacasia antiquorum Schott. Leaf spot and blight of beans Seedling rot and leaf blight of brans Blight of cowpea	Leaf spot of cluster beans	Leaf spot of soyabean Leaf spot caster Leaf spots of Pan or betel Leaf spot	Leaf spot of Mango Leaf spot of Jasmine Black rot of cabbage	Bacterial blight of Paddy
(1)	Arum maculatum	Cyamopsis tetragonoloba L. Taub Cajanus vajan L. Millap	Chyscine max L. Metr	Mangifera indica L Jasminum sambac Soland Readish, cabbage, canliftoer etc. highly susceptible.	Oryza sativa L

8. List of Published Antibiotics Showing Antifungal Action

TABLE No.11-15

List of Tublished Antibiotics which show Antifungal Action

}	Organism	Name of antibiotic	Specificity of action	Remarks
	(1)	(2)	(3)	(4)
+	1. Streptomyces nowrsei	Mystatin (Mycostatin)	Active against Candia albicans Glocei- Used successfully in treatment dioides immitis, Blastomyces moniliasis and also in coccidioi mycosis and blastomycosis.	Used successfully in treatment of moniliasis and also in coccidioi do mycosis and blastomycosis.
4	2. Streptomyces (From Pimpri soils) Antifungal substance	Antifungal substance	Active against Candida albicans Cryptococcous neoformans History's ama sp. Sporotrichum Schenkii.	:
m ⁱ	3. Streptomycetes sp.	Polyments. Type— (1) Tetrache: Fungicidin Antimycosip Rimocidin Chromin. (2A) Pentaena: Amphotericin and fungi chromalip Eurocidin. (2B) Filipin Mediocidin. (3) Hexaene Flavacid. (4) Heptaena Ascosin, Candidocin Trichomycin Candimycin Amphotericin B.	All these polyenic antibiotics show antifungal activity against yeasts and filamentous fungi like Aspergillus.	All these polyenic antibiotics show Amphotericina A and B have been antifungal activity against yeasts and used for treatment of disseminated filamentous fungi like Aspergillus. coccidie desycosis.
4	4. Bacillus subtilis	Bacillomycin	Active against Apsergillis Penicillia and skin pathogens.	:

9. DISEASES OF VEGETABLES IN STORAGE

TABLE No. 11-16

Diseases of Vegetables in Storage in Market

Name of Vegetable (1)	Diseases (2)		Causal organism (3)
Amarantaceae			
Amarantus paniculata .	Leaf spot and w rust.	hite	Alternaria amaranthii.
Amarantus viridis L	White rust		Albugo bliti.
Chenopodiaceae			
Beta vulgaris L. (Beet root).	Fusarium rot		Fusarium oxysporum.
(Bee: 1001).	Leaf spot		Cercospora beticola.
Spinacia oleracea L. (Spinach).	Leaf spot	• •	Phyllosticta spinaciae Lam.
Convolvulaceae <i>Ipomoea batata</i> Lam.	Rhizopus rot Soil rot Charcoal rot Soft rot Black rot Leaf spot Tuber rot White rust		Solerotium rolfsii. Macrophomina phascoli. Rhozoctonia solani. Ceratocystis fimbriata. Cercospora timorensis. Sclerotium rolfsii.
Compositae Lactuca sativa L	Leaf spot	7	Alternaria lactucae: Cercospors longissima.
Cruciferae Brassica oleracea var. capitata L.	Black-leg diseas Black rot	Ξ	Phoma lingam. Xanthomonas campastris. Alternaria brassicola.
Brassica leracea vat.	Alternaria spot		Alternaria brassicae.
botrytis L.	Black spot		Pestalotia brassicicola.
	White rust		Albugo candida.
	Leaf spot and b	light	Alternaria brassicae.
Brassica Oleracea var.	White rust		Albugo candida.
gongylodes L.	Leaf spot and b	light	Alternaria brassicae.
Cucurbitaceae Citrullus vulgaris var. fistulosus stock (Tinda).	Fusarium rot		Fusarium oxysporum.
3	Phoma rot		Phoma cucurbitacearum.
Coccinia indica	Anthraenose		Colletotrichum lagenarium.
	Black rot		Alternaria tenuis.
Cucumis melo var. ultissim Roxb. (Dhendsi).	aus Anthracnose		Colletotrichum.
Luffa acutangula Roxb.	Black rot		Macrophomina phaseoli.
(Ridge ground) (Padval)	Soft rot		Pythium aphanidermatum.

TABLE No. II-16-contd.

Name of Vegetable	Diseases	Causal organism
(1)	(2)	(3)
Luffa cylindrica L. Roem (Sponge ground or Ghosala).	Soil rot	Macrophamina. phaseoli and fruit rot due to Fusarium oxysporum.
Momordica charantia (Bitterground) L. For	Fusarium rot	Fusarium oxysporum.
Karali.	Soft rot	Pythium aphanidermatum,
Lagenaria leucantha Rusby (Bottle ground).	Black rot	Botrydiploia theobromae.
(Bottle ground).	Anthracnose	Colletotrichum lagenarium.
Cucumis sativus L (Cucumber, kakdi).	Anthracnose	Colletotrichum lagenarium.
	Fusarium rot Soft rot	Fusarium roseum. Pythium aphanidermatum.;
Schium edule Sw (Chow-Chow).	Fusarium rot	Fusarium oxysporum.
Euphorbiaceae Emblica officinalis	Fruit blemish	Ravenelia emblicae.
Gramine Zea mays L. Maize or Corn	Blemish disease	Alternaria tenuis, Curvular lunata.
Leguminosae Archis hypogae L (Groundnut),	Dry rot of seeds and nut rot.	Asperxgillus niger, Rhizo tonia bataticola, Curvular lunata and Rhizopus nigrican
Cyamopsis tetragonoloba L. Taub. (Cluster beans).	Anthracnose	Colletotrichum capsici.
Dolichos lablab L. (Pavata)	Anthracnose	Colletotrichum lindemuthianum
, ,	Cottony lak	Phytophthora parasitica.
Phaseolus lunatus L (Lima beans).	Anthracnose Pod spots	Colletotrichum capsici, Diplod phaseolina. Alternaria tenuis, Curvularia lunata.
Phaseolus vulgaris L	Anthracnose	Colletotrichum lindamuthianun
(French Bean).	Leak disease	T
Pisum sativum L. (Pea)	Anthracnose Leak	Colletotrichum pisi Phytop thora parasitica.
Trigonella focnumgraccum L. (Fenugteek, Methi).	Leaf spot	Alternaria tenuis Cercospora traversiana.
Vigna catijang var sinensis	Anthracnose	Colletotrichum lindenuthianum.
(Chavali).	Phoma fruit spot	·
Liliaceae Allium cepa L. (Onion)	· ·	Aspergillus niger.
		Pseudomonas marginalis.
	Dacterial SUIT 10t	Escucionionas marginaus.

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TABLE No. II-16-contd.

Name of Vegetable	Diseases	Causal organism
(1)	(2)	(3)
Allium sativum L. (Garlic)	Black mold rot	Aspergillus niger.
	Bacterial wet rot	Erwinica carotovera.
Malvaceae Hibiscus cannabinus L	Leaf spot	Alternaria dianthi Cercospora
(Ambadi) Abelmoschus esculentus L	Fusarium rot	hibiscina. Fusarium semitectum.
(Bhendi).	Leaf spot	Cercospora malayensis and C. abelmoschi.
Polygonaceae Rumex vesicarius L. (Chuka).	Leaf spot	Phyllosticta acetosae and Cercospora sp. Peronospora rumicis.
Rutaceae Murraya koenigii Spreng (Kadu limb).	Leaf spot	Colletotrichum gloesporioides.
Solanaceae Capsicum annum L. (Mirchi)	Anthracnose	Colletotrichum capsici (Syd) B. and B.
	Alternaria rot Ripe rot	Alternaria tenuis. Gloeosporium piperatum.
	Black rot	Rhizoctonia bataticola.
	Phoma rot Fruit spot	Phoma capsici. Bipolaris tetramera.
	Phytophthora rot	Phytophthora parasitica.
Lycopersicum esculentum	Alternaria rot	Alternaria solani.
Mill. (Tomato).	Soft rot	Phytophthora parasitica.
	Phoma rot Anthracnose	Phoma destructiva. Colletotrichum phomoides.
	Waxy rot Cladosporium rot	Geotrichum candidum. Cladosporium fulvum.
Solanum melongena (Brinjal)	Alternaria rot Phomopsis rot	Alternaria tenuis. Phomopsis verans.
Solanum tuberosum L (Potato).	Ring rot Dry rot	Pseudomonas solanacearum, Fusarium trichothecioides and F. caeruleum.

10. FUNGI ON MEDICINAL PLANTS

TABLE No. II-17

Fungi on Medicinal Plants in Maharashtra

Serial	Name of the Host	Host		Causal organism	Parts affected	Distribution
€ €	(2)			(3)	(4)	(5)
<u>.</u> -	Family Nymphyaceae Nelumbium speciosum	:	;	Fungus Physoderma narasimhanii Thirum and Leaves Pacgi.	Leaves	Pune, Karad.
ч	Nelumbium speciosum	:	:	Physoderma nelumbi De Bary	:	., Nasik.
п.	Family Cruciferae Brassica juncea	:	:	Alternaria brassicae (Berk) Sacc L	Leaves	Pune.
III.	Family Rutaceae Citrus aurantifolia	;	;	Phytophthora palmivora	Plant	General distribution.
5	Family Anacardiaceae Anacardium occidentale	:	:	Phytophthora palmivora	Fruit rot	General distribution.
6	Family Leguminoceae Pongamia pinnata	:	:	Chaetothyrium mundkurii Tilak	Plant	Khandala.
				Phyllachora pongamiae (Berk and Br.) L. P. Henn.	Leaves	., Pune.
7	Cassia fistula	:	:	Dia!:ypella cassiae Tilak T	Twigs	Aurangabad.
o c	Cassia fistula	:	:	Dothiella cassiae Tilak	Stems	Aurangabad.
6	Pongamia pinnata	:	:	Ravenelia hobsonii Cooke L	Leaves	Pune, Khandala, Vita near Karad.

TABLE No. 11-17-contd.

Serial	Name of the	Host		Causal organism Parts affected	Distribution
ŠΞ	(2)			(3)	(5)
VI. 10	Family Caesalpineae Cassia siamea	;	:	Cercospora cassiaesiameae Chid Leaves	Pune.
	Cassia fora	:	:	Cercospora cassiocarpa Chipp Leaves	Pune.
VII.	Family Mimosae Albizzia lebbek	:	:	Ravenelia sessilis Berk	Aurangabad, Pavnar, Nagpur.
12	Albizzia procera	:	:	Circinotrichum maculiformae Nees ex Persoon	
VIII. 13	VIII. Umbelliferae 13 Hydrocotyle asiatica	:	:	Cercospora hydrocotyles Ell. et Ev Leaves	Pune.
X. 14	Family Apocynaceae Nerium odorum	:	:	Cercospora neriella Sacc.	Punc.
X. 15	Family Acanthaceae Leptadinia reticulata	:	:	Cercospora leptadeniae Leaves	:
XI. 16	Family Pieraceae Piper betel	:	:	Capnodium betelei Syd. and Butler Leaves	General distribution.
XII.	Family Euphorbiaceae Ricinus communis	:	:	Phytophthora parasitica Hesse.	Khandala.
XII ¹ 18	Family Dioscoriaceae Dioscorea sp.	:	:	Cercospora carbonacea Miles Leaves	., Khopoli.
XIV. 19	Family Liliaceae Aloe vera	:	:	Uromyces aloeae Magnus Leaves	Pune, Aurangabad

11. FUNGI ON ORNAMENTAL PLANTS

TABLE No. II-18

Fungi on Ornamental Plants in Maharashtra

1 Family Magnoliaceae 2 Michelia champaca 3 Nymphyaceae Nymphyaceae Nymphyaceae Nymphaea speciosum 4 Family Crucifereae Brassica juncea 5 Family Leguminosae (Papillio Fomsamia klubia 6 Family Mimosae Albizzio lebbek	Causal organism	Parts affected	Distribution	
ae (Pap	(3)	(4)	(5)	
	Pestalolia micheliae Kalani	Leaves	Katraj-Pune.	
Magnolia sp Nymphyaceae Nelumbium speciosum Nymphaea speciosa: Family Crucifereae Brassica juncea Family Leguminosae (Papfornamia glabia Family Mimosae Albizzia lebbek	Phyllostricta michelicola Vasant Rao	Leaves	Pune.	
Magnolia sp Nymphyaceae Nelumbium speciosum Nymphaea speciosa: Family Crucifereae Borssica juncea Family Leguminosae (Papfornamia glabia Family Mimosae Albizzia lebbek	Robillorda trichetrae Vasant Rao	Leaves	Pune.	
Nymphyaceae Nelumbium speciosum Nymphaea speciosa: Family Crucifereae Brassica juncea Family Leguminosae (Pap Fornamia klabia Family Mimosae Albizzia lebbek	Phyllosticta magnoliae Sacc.	Leaves	Pune.	
Nymphaea speciosa: Family Crucifereae Brassica juncea Family Leguminosae (Pap formamia glabia Family Mimosae Albizzia lebbek	Physoderma nelumbi Mishta and Thomn	Leaves	Pimpri, Pune.	
Nymphaea speciosa: Family Crucifereae Brassica juncea Family Leguminosae (Pap Family Alabia Family Mimosae Albizzia lebbek	Alternaria tenuis Auct	Leaves	Aurangabad.	
Family Crucifereae Brassica juncea Family Leguminosae (Pap Forgamia glabia Family Mimosae Albizzia lebbek	Ramularia nymphaeorum (All.) Rem.	Leaves	:	
Family Leguminosae (Pap Forgamia glabia Family Mimosae Albizzia lebbek	Alternaria brassicae (Bark) Sacc.	Leaves Petiole	Khcd.	
	illionaceae)	Leaves	Pune, Khandala, Vi	Vita bear
	Ravenelia sessilis Berk	Leaves	. Pune.	
Albizzia procera	. Circinotricum maculiformae Nees ex Persoon	иос		

TABLE No II-18-contd.

Ξ	(2)			(3)		€		(5)	
-	7 Family Caesalpinaceae Cassia stamea	:		Cercospora cassiae Child.	Leaves	:	:	Pune.	
	Cassia tora	:		Cercospora cassiocarpa Chipp.	Leaves	:	:	Pune,	
	Cassia nodosa	:		Sphaerulina trifolia Rost	Leaves	:		Aurangabad.	
	Cassia medica (C. sophora)	:	•	Mycosphaerella cassiae Tiłak					
	Bauhia V ahlii	:		Phyllachora bauhiniae (Wint) Thiss. ex	:	:		:	
00	Family Rosaceae Rosa sp.	:	•	Sydow Phyllosticta rosae	Leaves	:	:		
2	Family Lythraceae Lagerstroemia parviflora	:		Cercospora lathracearum Heald Werf	;	:		Khandala.	
	Lagerstroemia lanceolata	:	•	Cercospora lathracearum var. macrospora Child.		:		Pune.	
91	Begoniaceae Begonia species	:		Allernaria Ienuis vat. rosicola	:	:		:	
7	Hydrocotyle asiatica	:	•	Cercospora hydracotyles Ell. et. Er.	Leaves	:	:	Pune.	
12	Araliacea c Aralia chinensis	:		Aliernaria araliae					
13	Rubiaceae Ixora drachiala	:	•	. Phyllosticta ixorae Hangel Robillardia sessibis Sacc.	Leaves Leaves	::	::	Pune. Pune.	

Pune. General.	Pune. Pune. Pune, General distribution, Aurangabad. Pune.	Kolhapur.	General distribution.	Pune.	General distribution Pune Pune. General distribution Duna	Dune Dune	Bhusaval and Pune,	Amba Ghat.	Pune.	Aurangabad. Punc. Punc.
: :	:::::	:	:	;	:::	:	:	:	::	:::
Flowers Leaves	Leaves Leaves Leaves Leaves	Leaves	Leaves	Leaves	Leaves Leaves Leaves	Leaves	Leaves	Leaves	Leaves Twigs	Branches Leaves Leaves
:::	::	; ;	Ş						::	· ·· · · · · · · · · · · · · · · · · ·
:::		::	:	hire			9	ins	, ::	
Choanephora simsonii Cunn Acrosporium sp. Sphaerotheca fuliginosa (Schl)	Alternaria casotiniana Unam: Alternaria chrysanthemi T. Sch. Alternaria tenuis Auct. Acrosporium sp. Phyllosticia chrysanthema Heald and Wolf.	Puccinia helianthi Schw Alternaria tenuis	Acrosporium sp	Alternaria brassicola (Schw) Wiltshire	Alternaria zirniae Papc. Cercaspora zirniae Ella and Matt Phyllosticia zirniae P. Brun. Cercespora chrystothemi Herald	Cercomora cosmi Chidd.	Cercospora granulissima Rangel	Colletorichum olac (Butler) Cummins	Cercospora neriella Sacc. Chaetosphaeria poonensis Kalani	Botryosporium indicum Tilak Cercospora ipomoea Winter Cercospora ipomoeae var. illustriae
::	;	:	:	:	:	:	: :	:	::	:::
::	:	:	:	:	:	:	: :	:	::	:::
Family Compositeae Zinnla elegans Cosmos bipinatus	Chrysanthemun indicum	Helianthus annus:	Dahlia variabilis	Gerbera jacksonii Bdus	Zinnia elegans		Dahlia sp	Family Oleasceae Olea dioica	Family Apocynaceae Nerium odorum Allamanda cathartica	Family Convolvulaceae Ipomoea palmata ipomoea hederaceae Ipomoea illustris
4								15	16	11

TABLE No. II-18-contd.

(5)	Pune.	:	Aurangabad.	Pune.	Aurangabad.	Pune.			Pune.	Pune.	Pune.	Khopoli.	
	:	÷	:	:	:	:			:	:	:	:	ļ
(4)	Leaves	Stem	Leaves	Leaves	Leaves	Leaves	SA.	_	Leaves	Leaves	Leaves	Leaves	Leaves.
	:	:	:	8					:	:	;	:	:
	:	tao	:	:					:	:	:	:	:
(3)	Cercospora leptadeniae Child	. Amphispheria gymnosporiae V. Rao.	Phyllosticta bryosiana	Acalypha.	Oidiopsis sp.	Phyllosticta crotoniphila Zoeg.	Fusarium oxysporium	Uromyces aloes Magnus	Phyllosticta criniola Ziemaszko	Phyllosticta cannicola V. G. Rao	Phyllostica gladiocides Butista	Cercospora carbonacea Milas	Phomopsis pandani Died.
	:	:	:	:	:		:	:	:	:	:		
	:	:	:	:	:		:	:	:	:	:	•	
(2)	Family Asclapiadaceae Leptadenia reticulata	Family Nyctaginaceae Bougainvillea spetabilis	Euphorbiaceae	Scalypla sp	Euphorbia geniculata	Scitaminaccac	Musa sapientum	Liliaceae Aloe vera	Amaryllidaceae Crinum sp.	Canna indica	Iridaceae Gladiolus	Dioscroreaceac Dioscorea	Pandanaceae
(E)	18 Fan Lep	19 Far Bou	20 Eup	Sca	Eup	21 Sci	M	22 Lili Alo	23 Am Cri	Car	24 Irid Gla	25 Dio Dio	26 Pan Pan

12. DISEASES OF FOREST TREES AND LEAF LITTER FUNGI:

Many wild plants are attacked by fungi, providing hosts for various fungal diseases which spread to economic plants also. The most important fungi on the principal forest trees are given here. For control measures, works on Forests mycology can be consulted. The most important product of Maharashtra forests is timber which is very often left in field and in stalks in open and gets attacked by Fungi Imperfecti or mushrooms and Polypores. There is need of much work on them than it has been done at present. It is well-known that the most important timber tree of Maharashtra is *Tectona grandis*. It is affected to a large extent in winter months by *Uncinula tectoniae* which causes heavy damage to timber as well as tree.

However, when the forest tree leaves fall to the ground they improve the texture and fertility of the forest soil by rotting the debris fallen on the ground. In this process of soil building and improvement the leaf litter fungi like Circinotrium, Beltrania and other Hyphomycetes are very important as they are found practically on all rotten leaves on floor in a dense forest. Some fungi, particularly species of Fusaria, attack roots of Conifers and Rosaceae. They have symbiotic fungi, mycorrhiza, in them. It greatly helps them in mineral nutrition although it must be noted that coniferous forest do not exist in the tropical and sub-tropical climate of Maharashtra. They occur in Pygium gardeneri above 5000'. In the past however, there were areas where members of the Rosaceae were there as is evident from the fossils of Rosaceae found in the Deccan Intertrappean beds. Many grass roots are also affected by mycorrhiza due to genus Rhizoctonia or Fusarium. Like forest trees, fungi also attack garden plants and medicinal plants. A garden is an artificial area where selected plants are cultivated, often exotic or from other places. fall victim to fungi. A forest on the other hand, is natural growth of vegetation, and only partly cultivated by introducing new species. It is, therefore, mostly natural and only partly cultivated. Along with the cultivated plants come fungi and viruses. The same thing is true of ornamental plants and medicinal plants. There are very few gardens of drug yielding plants. Most of them are collected from their natural habitat by plant collectors. The cultivation of drug yielding plants is done in the gardens of medicinal plants at Jammu and Shrinagar. In this State at Pune, there is the Jawaharlal Nehru Udyan or garden of Ayurvedic medicinal plants.

The diseases on medicinal plants need greater attention as they affect the photosynthetic activity of hosts and their products. A large number of leaf spot fungi are present on them. Since many drugs are extracted from leaves, bark and roots of medicinal plants which are stored in non-airconditioned rooms, they get heated up, and are used as such by the pharmacists, without examining pathogens on them. It is highly desirable, therefore, that diseases of these plants are known to pharmaceutical works, so that they can avoid use of diseased parts. (See Table II-17, pp.-191-92).

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12.1. DISEASES OF FOREST TREES TABLE No. II-19

Diseases of Forest Trees

Name		Causal Organism	Parts affected (3)	
(1)		(2)		
Ca ssia fistula		Diatrypalla cassiae Tilak Dothiella cassiae Tilak Phyllactinia corylea (Pers) Karst.	Twigs. Twigs. Twigs.	
Cassia tora		Diaporthe sp	Stem.	
Emblica officinalis		Aspergillus niger V. Tiegh.		
Hardwickia binata Roxb,	••	Fusarium sp	Root, Stem, Leaves.	
Acacia arabica		Calosphaeria acaciae Kale Diatrypa acaciae Tilak Phyllactinia acaciae Syd Sphaerostilbe acaciae Tilak Cytospora acaciae Tilak and Roek Diplodia acaciae Tilak and Rokde. Fusicaccum indicum Tilak and	Stem. Stem. Leaves. Branch. Stem. Stem.	
Acacia catechu	••	Rokde. Haplosporella acaciue Tilak and Rao. Erysiphe acaciae Blumer. Collectotrichum catechu Died	Stem. Pods.	
Terminalia chebula	••	Phyllactinia terminaliae Ramk Masseela terminaliae Patwardhan.	Leaves. Leaves.	
		Cercospora catappae P. Henn.	Leaves.	
Terminalia tomentosa	••	Phyllactinia terminaliae Ramk, Clavaria sp.	Leaves.	
Bambusa nana	••	Ascochyta bambusinae Vasant Rao.	Leaves.	
Ficus glomerata	••	Capnodium anonae Pat. Cerotelium fici (Butler) Arthu	Twigs. ir	
		Phyllosticta ficicola Pat	Leaves.	
Aegle marmelos Core		Acrosporium sp. (Oidium Link)	Leaves.	
Lagerstroemia flos-reginae		Ciliochorella mangiferae sydow	Leaves,	
		Lophodermium indicum Tilak	Leaves.	
Lagerstroemia lanceolata	٠.	Cercosporalythracearum var. macrophora Chiddarwar.	Leaves.	
Thespeshi populnea	••	Septoria thespesiae Ramakri Tis.	Leaves.	

PUNGI

TABLE No. 11-19-contd.

Name		Causal organism	Parts affected	
(1)		(2)	(3)	
Eucalyptus globulus	• •	Beltrania rhombica O. Renzig Circinotrichum maculaeformae Ne	es	
		Monochaetia syringae (Oud) Allech. Pestalotia dissiminata Theum	Leaves,	
		Ciliochorella eucalypti Viswanathan.	Stem.	
		Phyllosticia eucalypti Thuem	Leaves.	
Grewla asiatica	••	Uredopeltis grewiae (Cummins) Sath.	Leaves.	
Allanthus excelsa	••	Cercospora allanthicola Patwardhan.	Stem.	
Madhuca latifolia Roxb. (Bassia latifolia).	••	Scopella echinulata (Niessl.) Mains. Uromyces echinulatus Niessl.		
Morus alba	••	Mycosphaerella indica Viswanathan. Phyllactinia corylea (Pers) Karst. Ceroteliumfici (Butler) Arthur.	Leaves.	
Salmalia malabarica	••	Diatrype salmaliae Tilak Haplosporella. Spp.	Stem.	
		salmaliae Tilak and Rao	Stem.	
Dalbergta sissoo	••	Phyllactinia yarwoodii Patwardhan. Uredo sissoo Syd and Butler.	Leaves.	
		Colletotrichum gloeosporinides	Leaves and twigs.	
Dalbergia latifolia	••	Penz Cercospora dalbergiae alatifoliae Chiddarwar.	Leaves.	
Tansarindus indica	••	Phyllosticta tamarindiicola V. Rao.	Leaves.	
Eugenia jambolana	••	Plagiostigme deodikorii Ananth. Circinotrichum maculacformae Nees ex Pers. Pestalotia carrisae Guba Pestalotia eugeniae Thuem	Leaves. Leaves. Leaves.	
Tectona grandis L	••	Selenophoma kamatii Kalani Auricularia mesenterica Br. Uncinula tectonae Chaconia tectoniae Ramkrishnan T.S.K. Ramkrishnan. Cerocospora tectoniae Stevens.		

13. REGIONAL WHEAT RUST RESEARCH STATION MAHABALESHWAR;

The wheat crop is cultivated in Maharashtra mainly in Rabi season. The species grown is Triticum vulgare or what is known as soft wheat. The wheat plant is attacked by many plant pathogens, the most destructive among them causing loss in yield are the rusts. Earliest record of rust epidemic was in 1927 in Central Provinces. It reappeared in 1939, and in a severe form in 1946-47, in parts of Maharashtra, Madhya Pradesh and Rajasthan. Two million tonnes of wheat was supposed to have been destroyed by it. In order to investigate causes of such huge losses, a Regional Wheat Rust Research Station was established at Mahabaleshwar for determining the resistant varieties of wheat generally cultivated, and for testing the resistance of newly bred varieties. There are three rusts associated with the wheat crop in India.

- 1. Stem rust or Black rust due to Puccinia graminis tritici.
- 2. Leaf-rust or Leaf brown rust due to Puccinia recondita and
- 3. Stripe or Yellow rust due to Puccinia striiformis.

These three rusts are distributed in our country in definite pattern.

The stem rust *Puccinia graminis tritici* occurs in more severe form in Peninsular and Eastern India, though it does occur in all parts of India here and there.

Brown rust occurs all over India and can occur in any part of the country.

In Maharashtra, yellow rust has not been observed but only stem and leaf rust are known to occur. The stem rust occurs in Maharashtra and is more destructive than leaf rust. Stem rust can infect wheat crop at any stage, producing oblong brown dusky pustules in any given parts stem, leaf, sheath. The pustules enlarge, fuse and form big lesions, containing thousands of Urbedospores. At maturity they turn black and plants shrivel. The grains get shrunk and yield goes down. The infected plants have a tendency to lodge. The infection is spread by wind. It comes from adjoining fields. The rust remains on self sown wheat plants in fields throughout the year in the hills of Peninsular India, Nilgiris, due to low temperature and humidity. As the new crop starts growing the spores from the lodged plants in the hills remain dormant. With early rains they start germinating and enter through stomata of young plants and form mycelia. They form single celled Uredospores. The spore mass increases and leaf epidermis ruptures. The initial infection gives rise to new uredospores and spreads infection to entire new green crop. Then the double celled teleutospores are formed but they are functionless and the life cycle is not complete, due to the unavailability of basidiospores, pycniospores and acciospores.

There are about 23 physiological races so far recorded in India as stem rust, namely 11, 14, 15c, 17, 21, 21-A, 24, 34, 34-A₁, 40, 40-A, 42, 42-B, 42-B₂, 43-B₃, 117, 117-A, 122, 184, 194 and 295. Out of these 11, 15-c, 21-A, 40-A, 42-B₂, and 122 are considered very virulent races. RA.E 17, 21 commonly occur on stem in Maharashtra. In recent years race 117-A, has been occurring with high frequency generally in second fortnight of January when temperature is low, humidity high and no or scanty rainfall.

Leaf or Brown Rust:

This also occurs throughout the country either in isolated or epidemic form. It is very much destructive in Northern India. In Maharashtra it is less damaging than the stem rust. It appears before the stem rust in Maharashtra generally in December. It has so far 15 physiological known races namely 10, 11, 12, 17, 20, 63, 77, 77-A, 77-B, 104, 106, 107, 108, 162 and 162-A. Of these races 12, 77-A, 71-B, 162-A are considered virulent. In Maharashtra races 77 and its biotypes and 162-A are seen in nature every year. Most of the cultivated varieties of wheat in Maharashtra are susceptible to leaf rust races. Hence leaf rust infection is often seen on races released for cultivation. However, it was also seen that varieties U. P. 125, HD-4502, Malavika, HD-2189 are resistant to leaf rust.

The best method to control rust is to grow rust resistant wheat varieties. In Maharashtra, Kalyan-Sona, Sonalika, NI-5439, NI-5643, UP-215, HD-4502, HD-2189, CC-464 are generally recommended for growing. Of these UP-215 and HD-2189 are resistant to both stem and leaf rust.

To determine the resistance of wheat varieties, the mature plants of released varieties are artificially grown under epiphytic conditions for rust. They are as follows:

Serial No.	Variety					Stem rust infection	Leaf rust infection	
(1)		(2)				(3)	(4)	
1	Kalyan-sona				A	80%	80%	
2	Sonalika		(ISSEE)			30%	80%	
3	NI-747-19	••	सहय	मव ज	<u>ा</u>	80%	80%	
4	NI-5439			••	••	80%	80%	
5	NI-5643		• •	• •	••	40%	60%	
6	HD-4502			••	••	40%	R	
7	UP-215	••		• •	••	R	R	
8	CC-464	••	••	••	••	R	40%	
9	HD-2189		••	••	• •	R	R	
10	HY-65 Dry wheat	••	• •	• •	••	80%	80%	
11	N-59	••		••	• •	80%	80%	
12	MACS-9		••		• •	80%	80%	
13	N-5749			••		80%	80%	

Another way of controlling rust is chemical method using fungicides. It is said to be less effective as the spraying of fungicide has to be done throughout the growing period at an interval of 15 days. Crop if irrigated, then spraying of Zinc or Manganese Thio-carbonate 02% has to be undertaken immediately after the first pustules appear on the crop and then second, third etc. have to be given at the interval of 15 days. Therefore to breed and test rust resistance in varieties the tests are carried out on experimental farm.

WORK BEING CARRIED OUT AT THE REGIONAL RUST RESEARCH STATION, MAHABALESHWAR

- 1. Maintenance of 23 races of stem rust and 15 races of leaf rust. They are being maintained in live form on NP-4 and Moha varieties which are maintained throughout the year.
- 2. Differential wheat variety for finding out rust races of stem rust are:—
 - (1) Little club, (2) Marquis, (3) Reliance, (4) Kota, (5) Arnautka, (6) Mindum, (7) Spelmar, (8) Kubanka, (9) Acme, (10) Einkorn, (11) Vernal, (12) Khapli.

Leaf rust differentials:

(1) Malakof, (2) Hussar, (3) Mediterran, (4) Democrat, (5) Carina (6) Brevit, (7) Webster, (8) Loros.

The infection types are produced by physiologic races of stem rust on differential varieties.

1. Immune varieties do not form uredia. They are very resistant varieties and have minute uredia surrounded by chloratic or necrotic areas. Very susceptible ones have large and coalescing but no necrosis. Occasionally only chlorosis. Moderately susceptible varieties develop small or medium sized uredia as green islands. They often coalesce but have no necrosis.

In heterogenous varieties all types of infections appear on the leaves. From experience it can be stated that infection resistant types are 0, 1, 2 and susceptible types are 3 and 4.

- (2) Second important work is being done.—Testing of resistance of fixed varieties. Each year 100-200 varieties are tested at the seedling stage.
 - (3) To make resistant varieties available to breeder as donor parents.
- (4) Resistance of fixed varieties is also tested. Some of the resistant varieties are as follows:—
 - (1) E 8667, (2) CPAN 1283, 1885, (3) CPN 1360, 1418, 1436, 1441, (4) Hybrid cultures of F_3 - F_6 generation numbering 10,000, are screened against the rust disease under artificial epiphytic condition. Seed of resistant plants of each generation are selected and on the basis of such vigorous testing are evolved resistant wheat variety for each of the following States.

Maharashtra, Madhya Pradesh, Gujarat Karnatak and Andhra Pradesh.

The following varieties are rust resistant for Maharashtra:---

(1) N-59, (2) NI 146, (3) N-I-284/5, (4) NI-917, (5) N-5749, (6) MACS-9.

Varieties of other states are different and they are also tested for rust resistance and recommended for cultivation.

(5) Study of Race Flora:

This station maintained rust trap nurseries at 20 different places in different agro-climatic zones. By study of the performance of released varieties and their strains more promising strains are sorted out. The rust trap nurseries have proved to be useful in analysis of different samples. Their cultivation is also done for detecting the physiological races.

It has been recently found that Race 147-B-1 of stem rust has started occurring with greater frequency in recent years.

The main utility of this station lies in recommending particular wheat oust resistant varieties to a particular region. Of late it also has started work on rust on groundnut, jowar and bajra.

The above information was furnished by Shri S. K. Ruikar, Mycologistin-Charge of the Regional Wheat Rust Station, Mahabaleshwar and by Dr. Y. S. Kulkarni, who was previous in charge of it.

- 14. BACTERIAL PLANT DISEASES IN INDIA
- (G. Rangaswami 1962 and other works may be cited here as authentic)

There are many bacterial plant diseases like fungal diseases of plants. Their study however on agricultural plants started with Erwin, F. Smith of U. S. Department of Agriculture in 1890, and now many of them are known. They were classified under Protophyta by Sachs and their classification has been reformed by Russian Bacteriologist Krassinikov (1949). He makes 10 Orders.

Classification of Bacteria by Krassinikov (1949)

Class Schizophyceae (Cohn, 1879) or Schizomycetes Microtabiomycetes (Naegeli 1857, Philip, 1955)

Fission algae:

- Order I. Pseudemonadales Rickettsides (Orla. jensen, 1921, Buch. e. Buch 1958).
 - II. Hyphomicrobiales (Douglao, 1956) (Breed, et al. 1944) Virales.
 - III. Chlamydobacteriales (Buchanan, 1917).
 - IV. Eubacteriales (Buchanan, 1917).
 - V. Actinomycetales (Buchanan, 1917).
 - VI. Caryophanales (Peshkaff, 1940).
 - VII. Beggiatoales (Buchanan, 1956).
 - VIII. Mexobacterales (Jhon, 1911).
 - IX. Spirochectales (Buchanan, 1918).
 - X. Mycoplasmatales (Preundt, 1955).

The sub-order Pseudomonadineae consists of seven families as detailed below:—

- I. Nitrobacteraceae-Oxidises ammonia to nitrates and nitriles to nitrates, autotrophic.
- II. Methanomonadaceae—Oxidises methane to hydrogen and carbon monoxide, autotrophic.
- III. Thiobacteriaceae—Oxidises sulphur compounds.
- IV. Pseudomonadaceae—Frequently oxidative, sometimes fermentative, heterotrophic or facultative autotrophic.
- V. Caulobacteraceae—cells attached to the substrate by means of a slack.
- VI. Siderocapsaceae—Cells free floating or attached to the substrate by means of capsular material.
- VII. Spirillaceae—Cells vibrio-like to spiral.

Of these, Pseudomonadales, Eubacteriales and Actinomycetales are of great importance for the economic plants. Pseudomonials are important autotrophic bacteria oxidizing ammonia to nitrites and then into nitrates, Methane etc. Methano-bacterium reduces carbon-dioxide to methane. Sub-order Rhodobacteriineae contains photosynthetic types. Eubacteriales are simple undifferentiated cells, rod-shaped or round. They are mostly soil dwellers and fix free nitrogen in Leguminous plants. They are heterotrophic and form root nodules. Some of them ferment glucose anaerobically. Their shapes are varied. As soil bacteria they are very important. Some of them are facultative anaerobic and some are aerobic. The family Bacillaceae has only two genera, but many species.

Bacillus: -25, and Clostridium-93 species which are agriculturally all important.

Actinomycetales has four families, some of them have septate or aseptate mycelium. Actinomycetaceae forms spores by fragmentation of mycelium and Actinoplanaceae forms spores in sporangia; other two families Mycobacteriaceae and Streptomycetaceae do not form spores.

Bacteria are the lowest forms of Thallophyta, and are also known as Schizomycetes. They are unicellular, without nucleus and chlorophyll. They reproduce by fission or linear division. They lead a saprophytic or parasitic existence. Many of them are pathogenic, causing diseases to man, animals and plants. Some of them are common to man as well as animals e.g., Bacillus of Anthrax. They feed on very simple substances in solution. They have "holophytic nutrition". They are supposed to be a connecting link between plant and animal world.

Another group of organisms similarly living on plants, animals and man are viruses which are more virulent than bacteria because viruses can live only on living organisms. They also cause many plant and human diseases. A new group of similar organisms, now reorganised only in recent years, is called *Mycoplasma*, supposed to be intermediate between Virus and Fungi. Their characterisation and details of metabolic requirements are not yet fully known.

There are six types of plant diseases:-

- 1. Those due to Bacteria or Schizomycetes.
- 2. Those due to Fungi.
- 3. Those due to Viruses.
- 4. Those due to worms and other animal parasites
- 5. Those due to plant parasites.
- 6. Deficiency diseases.

Many large treatises have been written on symptoms, etiology, spread and control of them, but that is outside the scope of this work, therefore, only important plant diseases will be dealt here with in a general way. Deficiency diseases are not uncommon due to want of some component of food or minerals, or their salt required for the proper metabolic processes. Die-Back of Citrus on santra or mosambi in Ahmadnagar and other districts, is supposed to be due to mineral deficiency of calcium and potassium. Band disease due to copper deficiency is believed to be responsible for the death of coconut trees in Konkan. Molybdenumm deficiency causes death of many fruit trees etc. They are the examples of such diseases and are difficult to treat or eradicate.

A lot of work on bacterial diseases of economic plants has been done in our State by M. N. Patel, V. P. Bhide, Y. S. Kulkarni and Monizt (1951); some of it is of great significance in plant pathology. It is nor possible to describe here either the symptoms or control measures foe bacterial diseases or other plant diseases. A few of them which are important from the view point of useful plants in this State are listed The bacterial diseases of plants commonly found in Maharashtra are given in Table No, II-14 pp. 185-186.

15. VIRAL DISEASES

Many viral diseases which affect the plant are highly infectious. Due to them the leaves, their veins, become yellow, form curly top mosaic rosettes, bunchy top; their veins get streaked out: Ringspot, dwarfing, blisters, formation of small leaves, hairy root, curling of leaf margins are the common symptoms. They seldom kill the plant, but seriously affect the growth and yield. They are supposed to be transmitted by insect vectors. Papaya mosaic, little leaf disease of brinjals, bunchy to p of banana, Katte or Marble disease, yellow vein mosaic of Hibiscus esculentum (Bhendi), curling of tobacco leaves, various species of bean leaves are some examples of common viral diseases in Maharashtra.

16. OTHER DISEASES DUE TO WORMS AND FLOWERING PARASITES

Some diseases of underground roots, tubers and rhizome are due to a variety of Nematodes. "Cocle" disease of wheat, root nodes of potato, brinjal, tomato, tobacco, piper, onion, soya-bean, Gladiolus, Solanum species quite often have the roots affected by the growth of worms. Moderate or low range of temperature and non-sterilised soil or soil contaminated by worms are the chief source of infection. Long rotation and keeping soil fallow for two-three years, fumigation are some of the control measures. Cocle disease of wheat comes from infected areas. If that is avoided and soil washed with salt water, the disease disappears

Angiospermic Parasites:

These are of two types: Those have green leaves and can undergo photosynthesis, and those without Chlorophyll or green leaves. They have no ability for carbon assimilation.

Loranthus and Viscum are the examples of semi-parasites or green parasites, whereas Cuscuta or Cassytha—a member of the Laurauae are examples of the other kind. The latter suck manufactured food from the host plants with their special suctorial organs 'the haustoria'. There are some serious root parasites growing on tobacco, jowar etc., such as (1) Broom rape or Orobanche—It also hosts on the roots of tobacco, brinjal, tomato and other Solanaceous plants. They are highly destructive. (2) Striga—Different species of Striga grow on the roots of sorghum or jowar, sugarcane etc. Spraying 5 ppm 2, 4 D helps a little but not much in eradication.

Besides these, there are other flowering parasites, but they are on wild plants, e.g. Aeginetia on roots of Euphorbia and other bushes, Christiansonia on Strobilanthes, Lantana camara, etc. Cistanche tubulosa grows on Salvadora persica and S. oleosa. But these will be considered separately under Parasitic plants. Cistanche is not so far known in Maharashtra.

17. MUSHROOMS

Edible and inedible.—The layman's notion that fungi are harmful and have no value as food is not entirely correct, as some fungi like yeast and mushrooms and agaries are edible. 'Mycos' or 'Mykes' originally means mushrooms. Some of these are edible and others poisonous; some others are not poisonous but also are not Bose (1940) has described edible mushrooms of India. Sathe and Rahalkar (1975) have estimated 28 species of Agaricus from South-West India, belonging to seven families. Of these Agaricus compestris L. ex. Fr. and Pleurotus cornneopias Roland are commonly edible. Purkayastha and Chandra (1976) have described 105 species of edible mushrooms belonging to 62 genera. While there are many poisonous or non-edible mushrooms. However, it is not easy to identify with certainty which mushrooms or agaries are edible and which are The general belief that white or uncoloured mushrooms or Agarics are edible and that all coloured mushrooms or agarics are poisonous is also not correct. The identification of poisonous mushrooms is the job for the experts, because out of two species of the same genus one may be edible and other poisonous. For example, famous Amanita muscaria which is Somalata according to Wason (1971) is edible and non-poisonous while Amanita phalloides (Death Cap) is not edible.

The colour shape, lamellae, taste, odor and spore are the characters generally used in identifying or distinguishing mushrooms. But as a general rule, it is advisable to know precisely which mushrooms or agarics are edible.

Eating mushrooms is quite common in temperate countries. They are quite tasty and nutritious in point of proteins and fats. They are also consumed in a similar way throughout Kashmir and States adjoining Himalayas, such as U. P., Assam, Sikkim, Bhutan, etc., but not in Peninsular India. Mushrooms are used in vegetables, soups, pulay, ice-cream, etc. They are considered delicacy on the table. However,

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they are slowly getting popular in large cities like Bombay, Nagpur, Pune, Aurangabad etc. In some places attempts have been made to raise the crop of mushrooms by special culture methods which are taught at Shrinagar in the Regional Research Laboratory which is a branch of Council of Scientific and Industrial Research (C.S.I.R.).

Studies on them are rather scanty and are being made in Council of Scientific and Industrial Research, by Shri Gupta at the National Botanical Garden, Lucknow, by Dr. B. V. Patil and his associates at Amravati, Dr. A. V. Sathe at M. A. C. S. and Dr. S. D. Patil at Poona University. The list of edible mushrooms and agarics is given from previous works, including that of Butler and Bisby (1918). The list of poisonous mushrooms is also similarly given.

17:1 List of Edible Fungi

(1) Agaricus comprestris Fr.

Locality: Surat and adjoining Dang region, and also Agaricus vaginata, A crosea which are edible.

- (2) Clavaria elata (Masses.) Morgaon.

 Stipe edible when young, Grows in coconut groves.
- (3) Clavaria pachyderma (Peck.) Morgaon.
- (4) Coprinus comatus (Mull, ex. Fr.) R. F. Gray, Locality: Bombay, Nagpur, Baroda and other places,
- (5) Coprinus micaceous (Bull.) Fr.
- (6) Hirneola auricula judae (Bull. per. St. Amans) Berk.

Locality: Khandala, Bombay.

(7) Hygrocybe pratensis (Per. ex. Fr.) Donk.

Locality: Nagpur.

(8) Lentinellus cochleatus (Per. ex. fr.) Karst.

Locality: Nagpur.

(9) Leucoagaricus naucinus (Fr.) Sing

Locality: Nagpur.

(10) Leucoagaricus cepaestipes (Sow. ex. Fr.) Patouill. Locality: Bombay, Pune.

- (11) Marasmius oreades (Bott. ex. Fr.) Fr.
- (12) Marasmius siccus (Schw.) Fr.
- (13) Morchella eoniea.

Morchella esculenta (Pers. ex. st Amans).

It comes from U. P., Kashmir.

- (14) Pleurotus cornucopiae (Paulet ex. pers.) Roland. Locality: Madhya Pradesh, Goa.
- (15) Pleurotus ostreatus Kummer (Jacquin. ex Fr.).

Locality: Baroda.

(16) Volvariella displasia (Berk and Br.) Singh,

Locality: Baroda.

(17) Volvariella volvacea (Bul. ex. Fr.) Smith.

Commonly cultivated in cultures by mushroom growers.

18. POISONOUS MUSHROOMS AND AGARICS

1. Amanita phalloides, known as Death Cap.—

Death of animals due to unknown causes is often due to eating this fungus. Colour creamy white but never pink or purple, brown. The gills are first white then cream coloured or even greenish in colour. Common in grass-lands adjoining forests. Spores white.

2. Amanita mappa (Bulbous Amanita).

Gill cap white with yellowish edge. Spores white, yellow cap on the gill cap distinguish it.

3. Amanita muscaria (Fly Agaric).-

It has bitter taste and brilliant dark scarlet coloured cap which is very large, sometimes 8 to 9 inches high and 6 to 8 inches across: Spores white.

4. Lapiota cristata (Crested Agaric).—

This is a small agaric with cap 2 inches in diameter. It strongly smells like radish. Colour white or creamy.

5. Entoloma lividum (Livid Agaric). -

Grows under large trees, dull or dirty yellow in colour. Spores pinkish.

- 6. Inocybe patouillardii (Red staining Inocybe) cap 2 1/2 inches across, red or brown, mild smelling, wax coloured. Edge always white, spores yellowish brown.
 - 7. Psalliota xanthoderma (Yellow staining Mushroom).-

Cap ball shaped, rather with a flattened top, pure, white silky with strong unpleasant odour. Gills dull pinkish.

8. Stropharis aeruginosa (Green agaric or Verdigris agaric).—

Grows on damp soil in forest and in grassy places. Gill cap blackish green or purple. Gills blackish purple with light radish smell.

19. POLYPORES AND DECAY OF TIMBER

Bracket Fungi or Polypores belong to the Class Basidiomycetes Order Hymenomycetales. They have sporophores or fruiting bodies which grow on the tree trunks and timber, very rarely on soil. The mycelium is produced from basidiospores, in tube-like basidia of various shapes. They may be sessile or may have a short stalk. The upper surface is smooth and variously coloured. But on the lower surface there is a hymenial layer from which the basidia are formed. The hymenium is the fertile region of the fungus from the lower surface of which sterigmata and sterile cystidia and setae are formed. They are highly susceptible to temperature and humidity and get dried up in hot weather. It has been found that the activity of the spore formation and wood destroying is stopped at a temperature 60 to 90°. They are also very susceptible to humidity, and under favourable conditions grow enormously all around the trunk of trees, or on the wood kept for drying. They some times work great havoc to forest logs and tree trunks by their hyphae ramifying inside them and spoil the quality of timber. They live on the food materials in the cells or the lignified walls and seriously affect wood reducing its strength. They also attack Bamboos and thereby hasten the FUNGI 209

decay. Such a Bamboo gives stained pulp, having lesser strength. Sometimes in depots the wood is so heavily attacked that the wood becomes almost pulp. Generally most of them attack sapwood but not the heart wood. The main decay causing fungi of wood are species of Fomes, Polypores, Ganoderma lucidum lenzites sepiaria Merulius lacrymans found on timber of different trees. Humidity and rainfall greatly influence the decay of wood.

TABLE No. II-20

19.1 Wood ROTTING FUNGI

- 1. Daedalea suberosa Mass (Pune)
- 2. Daedalea spp. Pune.
- 3. Fomes senex Nees and Mont. Bombay.
- 4. Ganoderma applanatam ((Pers) Pat. Khandaia
- 5. Gan. colosum (Fr.) Bres. Konkan, Pune.
- 6. G. lucidum (Leyss.) Karst. Kolhapur.
- 7. Hexagonia tenuis Hooker. Khandala.
- 8. H. subtenuis Lloyd, Bombay.
- 9. H. discopoda Pat and Har. Kolhapur.
- 10. Irpex canescens Fr. Khandala.
- 11. Irpex vellecus Berk and Br. Khandala.
- 12. Irpex spp. Kolhapur.
- 13. Lenzites ochrolenca Lev. Khandala.
- 14. Polyporus campbelli Berk, Pune.
- 15. P. gilrus Schw. Khandala.
- 16. P. grammocephalus Berk. Pune, Panhala.
- 17. P. hobsoni (Berk) Cooke, Bombay.
- 18. P. persooni Fr. Andheri, Bombay.
- 19. P. sanguineus Koltzsch, Andheri, Bombay.
- 20. P. umbilicatus Berk. Bombay.
- 21. P. ungulatus Berk var hobsoni Sau. Pune, Bombay.
- 22. Polystictus floridanus Berk. Khandala.
- 23. Polystictus occidentalis Koltzsch. Punc.
- 24. Polysticus persooni Fr. Andheri, Bombay.
- 25. Polystictus russogramme Berk. Khandala.
- 26. 1'. sarawalensis Berk. Khandala.
- 27. P. zanthopus Fr. Khandala.
- 28. P. zylanicus Berk. Khandala.
- 29. P. zonatus Fr. Bombay.
- 30. Polystictus sp. Amba Ghat, Dajipur, Radhanagari.
- 31. Poria carterii Berk. Bombay.
- 32. P. barbaeformis Berk et Curt. Pune.
- 23. P. poriginosa Berk. Bombay.
- 34. Trametes carterii Berk, Bombay.
- 35. Trametes sp. Khandala, Panhala.

20. SOIL FUNGI

Soil is a complex organisation derived from the underlying rock, mixed with remains of animals, debris and plants. It provides food to them during life-time and also a graveyard after death. In this ecosystem or the process of soil building, bacteria and fungi, rodents and excreta of animals, play important part and they enrich it by various life activities. The fungi and bacteria are thus soil building organisms helpful to man. They play a significant role in accumulating salts of different minerals and humus in soil. They hold together the various plant products, their exudates from roots and underground parts. It is well-known that rhizosphere of different species contains different fungi and bacteria, who generally are attracted to them by the auxins, carbohydrates, mucilage, hormones and other products of secretion from the roots. They also help in building soil and make it fertile by growth of mycelia. They are important in the formation of compost, but what exactly do they secrete, or what processes they help is not yet known.

The fungi that mainly take part in it are known. They mostly belong to Phycomycetes, Ascomycetes and Fungi Imperfecti. Of these Phycomycetes are the most important being soil builders. Their mode of reproduction being mostly vegetative, in Fungi Imperfecti such Fusarium, Rhizoctonia they are not only soil fungi but they also enter into partnership with grasses and other plants and lead a symbiotic life, Mycorrhiza often reproducing only by a sexual spores or conidia. They also play very important role in forest soils, inasmuch as they are the main litter builders and decomposers of cellulatic material. Without the presence of leaf litter fungi, deciduous and tropical forests would become infertile. Their role in moist soil and in soil at the bottom of shallow tanks, ponds and water reservoirs leads to a variety of life at the bottom of ponds, especially the Monoblepharidaceae. It is the main group which its activity make food for the aquatic animals and water plants. The soil fungi thus are extremely helpful from point of view of agriculture, horticulture and forestry.

Recently fungi have acquired special significance inasmuch as they have provided fungal resources for getting antibiotic substances Penicillin, Aureofungin, Chloromycetin etc. Their total potentiality for human welfare is yet to be fully understood. The lists of soil fungi common in this part of country and sources of antibiotics obtained from some of them are given in Tables below.

सत्यमव जयन

Principal families of soil fungi belong to *Phycomycetes* mainly: Mucoraceae, Saprolegniceae, Peronosporataceae, Pilobolataceae Pythiaceae,

Among Ascomycetes Pezizaceae and among Fungi Imperfecti Sphaeropsidaceae, Moniliaceae and Tuberculariaceae are important. The principal fungi concerned however are the species of Mucor, Rhizopus, Absidia, Circinella, Allomyces Pilobolus, Saprolegnia, Phytophthora, Cystopus, Pythium, Aspergillus, Penicillium.

But more troublesome members of soil fungi are those which belong to Fungi Imperfecti such as Phomopsis, Fusarium Rhizoctonia, Monilia, Botrytis, Xylaria, Rosellina etc. A large number of Hyphomycetes are leaf litter forming fungi. They are largely responsible for the decay of leaf molds, and humus formation in forests. In this Cladosporium, Cephalosporium, Chlamydorabra, Cycadomella, Emmsia, Sphaeronema (Indica) Torula multispora, Monosporium bharatensis. Microsporium

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gypsum are very conspicuous as soil fungi. It should however be noted that all of them occur at the same place or at the same time in agricultural fields or forest area. Generally species of Phoma. Cephalosporium are pretty common. In forest soils Cladospora are more abundant. The fungi also grow on the dung and excreta of wild and domesticated animals such as elephants, horses, cattle etc. Various species of fungi occur on them. Absidia regneria occurs on the dung of a camel as well as species Circinella spinosa which also occurs on the dung of buffalow. Helicostylum peforme grows on the dung of elephant. Sarcoscypha grows on highly rich humus soil. Many species of Agaricus such as Agaricus woodrowii, Bolbitius grandiusculus, Battararea levispora, Cyathus limbatus and Cyathus microsporus Dictyophora industata Pers. (1). falloides Desvaux) species of Lepiota grow on ground, dung as well as in open grassy pastures.

21. FUNGI OF PALMS, GRASSES AND SEED BORNE

Palms constitute a conspicuous group of plants in the coastal regions and are also cultivated in gardens, and orchards. They are economically important. Many of them die due to attack of *Koleroga* by *Phytophithora arecae* and a few other fungi. They being very tall, infection on them is hardly noticed till the cabbage of them is fully infected and the trees die.

Another disease of coconut palms is 'Band disease' which is a deficiency disease. The tree dies from top and becomes a prey to fungi. Borassus flabellifer dies due to nesting habits of birds. Infection on various Phoenix species due to Graphiola phoenicis is pretty common. Cocossucifera is also sometimes attacked by Ganoderma, Oidium, Pestilochia palmarum. Graphiola borei attacks Borassus flabellifer and also Exosporium palmivorum.' Phytopthora arecae causes damage to betel-nut trees.

Some imperfect fungi are seed borne. The fungus on the seeds of *Paspalum scorbiculatum* (Harikh) is known to cause symptoms similar to those of ergotine or opium. All these fungi need careful watching as they are consumed by cattle and man unknowingly. About 30 fungi are known on grasses.

The fungi growing on grass and fodder especially the smuts and Rusts cause damage to green grass and grains on storage. They harbour poisonous fungi too. Therefore, it is important to take a note of the fungi on fodder grasses and foodgrains consumed. Any fungus which grows on wild plants can as well affect cultivated or wild grass and their grains during some stage of their life cycle. Sometimes cattle die after eating them, especially the smuts. In Maharashtra, there are about 250 species of grasses. They are known to harbour 8 species of smuts, 1 of rust and 19 of other fungi.

22. Mycorrhiza

Some fungi affect roots of grasses and live symbiotically with them. Species of Rhizoetonia and Fusarium live symbiotically on the roots of Cynodon dactylion and other grasses and also on the roots of some ornamental and cultivated plants. Fusarium causes well known 'Wilt Disease' of cotton. The roots of conifers always live symbiotically with fungi. They harbour fungi on roots externally as well as internally. Such a fungal association with roots is known as mycorrhiza and is not uncommon.

23. USEFUL FUNGI

INDUSTRIAL USES OF FUNGI.—So far we have discussed the harmful role of fungi in causing diseases to plants, animals, man, his crops and useful plants, but it should not be considered that fungi are not useful. It is well-known that some of the Mushrooms form delicious food for man. Some are added to beverages for aroma and flavour. They yield various organic acids like glycolic, glucosonic, citric succinic acid etc.

But above all, the yeasts are known to produce alcohol, vitamins and enzymes since man started utilizing plants. The main groups useful for this purpose are Zygomycetes to which Mucor, Rhizopus, Absidia (all Phycomycetes) belong. Among the Ascomycetes Eurotium, Monascus, Neurospora yeast are important. They bring about a variety of fermentation so much so that a separate branch of technology called Fermentation technology has been developed. A new Fungi Imperfectilike Actinomycetes, various types of Hyphomycetes, Phoma, Aspergillus, Penicillium, Cladosporium, Helminthosporium, Alternaria are some of the more important fungi.

A new interest in industrial inycology has arisen with the discovery of Antibiotic Penicillin by Alexander Flemming in 1929 from the common green mold *Penicillium*.

Since the discovery of Streptomycin, there is a continuous search the world over for fungi and bacteria in soils. A few pharmaceutical works also keep on searching and preparing drugs from Fungi useful to man and the total number of antibiotics so far known is more than 2000. Many have been investigated only in the laboratory, only a few however reached the pilot or factory stage. The main difficulty in dealing with them is that many important fungi and their spores are usually propagated vegetatively. Like all lower fungi and bacteria they mutate rapidly and such changes are often prompted spontaneously or by the substrate, warm temperature. and other conditions in which the broth or culture is made. Therefore at every step extreme care is taken in preserving an antibiotic fungal strain. The same is true of various yeast strains as they produce both haploid and diploid spores. To preserve the same quality of yeast for bread making or for the production of alcohols immense care is taken and secrecy is maintained by the organizations concerned. The following Table gives the main industrial fungi and other micro-organisms and their useful products to man.

24. YEAST AND FERMENTATION

Use of yeast to man is known since very very long time. Industrially they yield alcohol, riboflavin etc. Yeast is used in fluffing wheat paste into bread known as Baker's yeast. It is different than Brewer's yeast giving alcohol by fermentation of sugary solutions. (see tables Nos. II-21 and 22)

25. FUNGI AND HUMAN DISEASES

Fungal attacks cause diseases to man also. The chief disease forming fungi belong to various groups especially to molds *Phycomycetes*. Actinomycetes and Fungi imperfecti. This branch of mycology is much neglected Types of diseases like Candidas causing superficial

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irritation are not easily removed. Phycomycetous Fungi and Fungi Imperfecti cause systemic disease which are more troublesome to irradicate, especially those causing pulmonary diseases like asthama, spores of various fungi responsible for deep infection of the pulmonary tract in man. On the other hand a disease like Madura mycosie is caused by Mycotoma or Allescheria boydii or some times by species of Aspergillus. In Maharashtra Rhinosporidium of nose and foot is quite common in workers collecting sand from river bed, or from estuarian and river beds. Species of Rhizopus and Mucor causing ear diseases are also common. A list of some common human diseases caused by fungi, for their symptom, etiology, distribution works like Medical Mycology by Moss and Mc Quiwn (1971), 3rd edition, be consulted.

Similarly there are many aquatic fungi and marine fungi which are quite important as they grow in lake water, estuaries and river banks causing diseases to aquatic animals. These branches are very poorly looked into by mycologists who mainly concern themselves with plant diseases, those too of crops.

26. Antibiotics and Their Sources And Antibiotics Discovered by Hindustan Antibiotics Ltd., Pimpri

Some diseases are also transferred from animals to man like T. B. and they are known as zoonoses. List of some diseases caused to man by fungi called from various sources, and the list of antibiotics used against some of them, are given in tables Nos. II-23 and 24.

In India some antibiotics have been discovered by the research staff of the Hindustan Antibiotics Ltd., Pimpri and that list is also given in table No.II-25.

सन्यमेव जयते

BOTANY AND FLORA

TABLE No. 11-21

Micro-organisms Producing Considerable Riboflavin and the effect of Iron on the Biosynthesis

	Organism				Riboflavin in culture fluid ug per mi	Optimum iron concentration by per ml
	(1)			···	(2)	(3)
1.	Mycobacterium smegmate	's			57.5	Not critical.
2.	Clostridium acetohutylian	um			97.0	1 to 3.
3.	Mycocondida riboflavina				200.0	Not critical.
4.	Candida flareri				567.0	0.04 to 0.06.
5.	Ashbya gorrypii				1,760.0	Not critical.
6.	Eremothecium ashbyeii	• •	_ 5	155	2,480.0	Not critical,

TABLE No. II-22
Alcoholtolerance of Certain Distiller Yeasts

No.	Yeast culture name	7			Alcohol tolerance per cent by Wt. alcohol
(1)	(2)		f		(3)
	स्यमेवज	पते			
2	Saccharomyces cerevisiae Housen	••	• •		5.79
19	Lygosacharomyces soja				4.82
1	Saccharomyces cerevisiae Housen		• •	٠.	7.72
26	Saccharomyces mellacei Jorgenson				7.72
24	Saccharomyces ellipsoidens Housen		• •		9.65
25	Saccharomyces Pombe				8.68
29C	Saccharomyces cerevisiae Hanson-Ra	sse >	KH		8.68
4C	Saccharomyces cerevisiae Hansen-Ra	sse >	ΚII		8.68
3C	Saccharomyces cerevisiae Hansen-Ra	sse 3	ζH		10.61
28C	Saccharomyces cerevisiae Rasse M	٠.			10.61
31C	Saccharomyces cerevisiae Rasse M				11.58
	_				

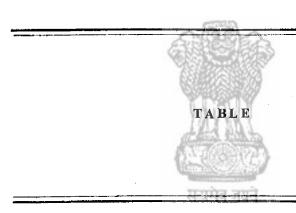


TABLE No. II-23

Fungal Diseases of Man

Seria! No.	! Name of disease	Causal organisms	is Parts affected	Distribution	Remarks
ε	(2)	(3)	(4)	(5)	(9)
-	Actinomycosis	Actimomyces israeti	Cervicofacial (57 percent) World-wide. Thoracic (15 per cent) abdominal (22 per cert) Cutaneous organalised	World-wide.	
7	Necordiosis	Nocordia asteroides	(6 percent)	World-wide	In both sexes.
ю	Mycotoma	Nocardia sp.	Any part but frequency the foot and hands.	World-wide	Men are more affected.
4	Trichomycous axillaries laptothrix.	aries Nocardia tenuis	. Infection of hair of the	Yellow variety World-wide.	Condition occurs in man and woman past puberty
5	Frythrasma	Nocardia minutissima	Webs and between toes	Red and black tropical It occurs at any affects men frequently	It occurs at any age, affects men frequently.
9	Cruptococcosis (Torulosis).	Erytococcus neaformans	Tissue central nervous system In all parts of world	In all parts of world	It affects men and women.
7	Cendidioris Monilians	ans Candida albicans	Any part of body	S. America	Occurs at all ages.

∞	Histoplasmeris	Histoptasma capsulatum		Reticulo-endothecial	Asia, Australia, Philli- Both sexes.	Both sexes.
6 ⁄	Aspergillosis	Aspergillus sp.	:	Even to birds, animals and insects	World-wide	Men are infected.
10	Phycomycosis	Mucorales Rhizopus oryge arrinisus Absidid	oryge Rhizopus Absidia corymbi-	Skin	World-wide	Both sexes at all ages.
11	11 Penicillosis	fera. Penicillium sp.	:	Pulmonary, Urinary tracts	and	sub- No age or sea bar.
12	Tinea nigra Palmarus	narus Clodosporium	:	Skin also other parts	Tropics and sub-	Both sexes at all ages.
13	Dermatomycoses Epi	Epidermophyton flaccosum (Harg) Langeren and Mito	faccosum and Mito	flaccosum Skin and nails and Mito	tropies. World-wide	Men and women are equally affected.
14	Tinea capitis	Microsporum	Hq o	Hair, skin	World-wide	Men and women are
15	Tinea corporis	Gruby 1845	144		:	equally allected.
16	Tinea capitis	:		3	:	:
17	Tinea corporis	Trichophyton	:	Hair, skin, nails	World-wide	Men and women are
18	Tinea barbae	Mentagrophyres	:			equant anceres.
19	Tinea crulis.	Robin				
20	Tinea pedis and	Blandhard 1896				
21	Tinea unquium.					

TABLE No. II-24

Antibiotics and Their Sources

	Antibiotic		Source
	(1)	·	(2)
Actinomycin	A. B. C.		. Actinomyces antibioticus etc.
Actinorubin			. Actinomyces Strain A 105.
Antimvein A	·		. Streptomyces (Unidentified).
Aspergillic a Aureothricin Ayfivin (sam and C).	(cf. thiolut		. Aspergillus flavus Aspergillus fareinicus. B Bacillus licheniformis Strain A. 5
Borrelidin Candidulin		4	. Streptomyces rochei. . Aspergillus candidus.
Chetomin			. Chaetomium cochliodes etc.
Citrinin		Ser.	. Penicillium citrinen etc. Aspergillus niveus.
Enniatin (a avenacin, sambucini	Fructigenin	(Lateritiin	n. Fusarium orthoceras Var ennicitinum etc.
Fumigacin (Helvolic acid)	. Aspergillus fumigatus.
Fumigatin		सवम	. Aspergillus fumigatus.
Geodin			. Aspergillus terreus.
Gladiolic ac	id		. Penicillium gladioli.
Gliotoxin	••	••	. Trichoderma lignorum (viride) Aspergilli and penicillia.
Glutinosin Glyco-lipidc	ariseolutein	••	. Metarrhigium glutinosin. . Pseudomonas aeruginosa.
L-Hydroxy-1 (Hemipyo Illudins		•••	. S. griseoluteus Pseudomonas pyocyanea. Caeruginosa.
M. and S.			, Clitocybe illudens.
Iodinin Javanicin Kojic acid Lavendulin	•••		 Chromobacterium iodinium. Fusarium javanicum. Aspergillus flavus, etc. Organism resembling Streptomyces lavendulae.

Antibiotic			Source
(1)			(2)
Licheniformin Marasmic acid Lenolic acid Nisin Patulin (clavacin clavatin Claviformin expansion). Penicilic acid	•••		Bacillus lichenif. Marasmius conignus. Penicillum brevicompactum etc. Bacillus subtilis 370. Streptomyces netropsis. Penicillium patuilin, etc. Aspergillus clavatus etc. Penicillium puberulum, etc.
Pleurotin Poactinomycin A, B, C.		F	Aspergillus ochraceus Pleurotus griseus. Proactinomyces (Nocardia) gardneri.
Prodigiosin	6		Serrațiaaeemarcescens.
Puberulonic acid Puberulonic acid Pyo compound Pyocyanine Pylolipic acid Streptolin Streptothricin Subtilin Thiolutin (cf. oureothricin Toluquinone 5-methoxy-p-toluquinone) Ustin, I, II, III Viridin Xanthomycin			Penicillium puberulum, etc. Penicillium aurantiovirens, etc. Pseudomonas acruginosa, etc. Pseudomonas acruginosa, etc. Pseudomonas pyocyanea. Streptomyces (Unidentified). Streptomyces lavendulae. Bacillus subtilis. Actinomyces sp. Streptomyces albus. Coprinus simulus. Lentims degner. Aspergillus ustus. Trichoderma viride. Streptomyces (Unidentified).
	TAI	BLE N	lo. II-25
	TIBIO	rics C	FROM THE RESEARCH DEPARTMENT CO. PIMPRI, WITH ORGANISMS THEM
1. Antismobin			Emoriceliopsis peonomis Thirum.
2. Antibiotic MyV-4			Streptomyces sp HA-MYC-4.
3. Antibiotic s-39			Streptomyces sp.
4. Antiprotozoin	••	• •	Streptomyces hygroscopicus vars indica.
5. Antibiotic relate mycin.	ed A	biro-	Chainia minuticclerotica.

6.	Aureofungin .			Streptoverticillium.
7.	Chainin			Chainia strain 3047.
8.	Dermostetin			Streptomyces viridigriseus,
9.	Fucothricin			Streptomyces sp. MYC-19.
10.	Hamycin			Streptomyces pimprina.
11.	Herbarin A and B .			Torulaharbarum,
12.	Herquinene			Penicillium herquei
13.	Hexin			Streptomyces sp. (AFS2).
14.	Necrocitin			Myrothecium roridium.
15.	Neoheptaenc .			Streptomyces sp. HA/711.
16.	Neopendaene .		-	Streptomyces sp. No. 2236.
17.	Streptorubrin .		•	Streptomyces rubrireticuli var pimprina.
18.	Streptombrin B .	08	3.6	Streptomyces reseoverticillatus var alberpora.
19.	Tetraenine A and B			Streptomyces frequentans Thirum.
20.	Streptorubrin A .		â	Streptomyces nibrireticuli var pimprina.

All these are used against several diseases,

27. FOOD SPOILAGE , MYCOTOXINS AND HUMAN HEALTH

Spoiling of food by fungi is known since long. Many molds contaminate food, especially on bread. They develop a toxin akin to lysergic acid-LSD. Grains of cereals affected by molds produce toxins called Mycotoxins. Leaves of coconut become yellow due to mycoplasma. Yellowing of rice grains and other cereals like maize also develop mycotoxins. Broken grains i.e. seeds of groundnut, Pristachio nut (Pista) are affected on storage, especially under damp conditions by molds like Aspergillus flavus or A. paraeitieus which produce mycotoxins. Some of these are quite serious and cause damage to human health, to cattle and poultry. They affect liver and kidneys by their toxins. Cattle can even die because of them. Species of Aspergillus like. A. flavus, A. clavatus are supposed to be carcinogenic. Some Fusarium species are also highly toxic. Aleukia which affects leucocytes is due to consumption of wheat and millet grains infected by Fiwarium S. P.

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SECTION C--LICHENS

1.	General Introduction to lichens in Maha-rashtra.
2.	Basidiolichens
3.	Distribution of lichens in India
4.	Biochemistry and Culture of lichens
5.	Component genera of lichens-Algae as primary symbiont.
6.	List of algal names as lichen symbiont
7.	Lichens in Maharashtra and Western India
8.	References

1. GENERAL INTRODUCTION TO LICHENS IN MAHARASHTRA

The next class of the Thallophyta is 'Lichens'. It is an association of two different components, one of which is an alga and the other a fungus; but together they make and look a single plant. The fungus is the dominant partner. It completely engulfs the algal component. They grow together and help each other. What the fungus alone cannot do, the fungus and alga together are able to do. The alga manufactures food by photosynthesis and supplies it to the fungus and the fungus utilizes algal products by engulfing the alga by its mycelium. Fungus provides salts. The two partners of each lichen are characteristic and do not change. They can rarely be separated. There are above 15000 known species of lichens, but according to some 20,000 in the whole world belonging to 400 genera. The number of algae in lichens is about 25, belonging to three families Cyanophyceae Chlorophyceae and Xanthophyceae; the fungal members belong to only 2 taxa. They alone constitute the fungal components, They are Ascomycetes and Basidiomycetes. In the case of algae Chlorophyceae are more common than Cyanophyceae. Since the fungal partner is dominant in lichens. the name is generally given after the fungal partners e.g. Ascolichens. Heterotrophic purple bacteria are also seen associated with lichens, but

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the separation and reconstitution of a lichen by synthesis is extremely difficult and has been rarely achieved as in the case of a Basidiolichen. In 1886 Bonnier succeeded in synthesizing various lichens from the two components and showed that it was possible to obtain fruiting bodies from the association of fungal hyphae and free algal cells isolated from it. Even at present it has not been possible to isolate the fungus and grow it to maturity in pure ascus culture.

It is obvious that this is a case of nutritive symbiosis, but sometimes when the algal partner is overpowered, it leads to helotism and the lichen dies. They grow on rock, soil, bark of trees, leaves and even on human skin.

They extend from extremely cold regions such as Arctic Tundra where randeer moss Cladonia rangifera grows to hot rocks. It forms dark carpets in Tundra, sometimes 15 to 30 cm thick. Lichens are the first colonisers of rocky habitats followed by Blue-green algae, mosses, liver worts etc. Because of the mucilage secreted by them they grow even in the chinks of rocks and bring about the decay of substratum. They are thus the real pioneers in a seral succession. They are classified according to fungal partner into (1) Ascolichens in which the Ascomycetes is one partner, and (2) Basidiolichens with a Basidiomycete as one partner. The algal as well as fungal partner are permanently fixed in a lichen.

Some of them form crust on the rock and are known as Crustose lichens e.g. genus Parmelia. Sometimes a lichen grows in bits as if parts of a broken layer, and sometimes all fragments grow together erect. If the humidity is high they dangle in the air as if branches of a tree, e. g. Usnea. Still others form rounded Cephalodia or heads and still others form thallus cups as in *Physcia*. The distribution of fungal hyphae and the algal particles is characteristic of each lichen. They form pseudohypodermal layers and sometimes a central layer in the thallus, Sometimes algal particules are scattered throughout thallus. reproduce vegetatively by fragments of thallus, Cephalodia are also formed as special joint reproductive bodies which in dry air form powder on the thallus and it slies off. They are called soredia and the group which germinates under such conditions is known as Sorelia. They also form pyenidium and spores in ascus cup, with fungal hyphae intercepting algal chains alternately. They can reproduce sexually in the case of Ascolichens by forming ascogenous hyphae, but attempt to separate them and bring about fertilization has not succeeded. They form two groups: (1) Pyrenocarpic where ascogonium lies within a perithecium and the other (2) Gymnocarpic. Here it lies in apothecium. Sixteen lichen families belong to group (1) and thirty-five families to the other Compared to them Basidolichens are very few. group (2).

2. BASIDIOLICHENS

Only 3 genera constitute the group and in actual growth they form concentric layers which look as if they are a polypore or an Agaricus. Algal component is generally Chroococus. Distribution of the two is irregular, alga forming lower or inferior layer, the fungus running through it above as a superior layer. Some Basidiolichens reproduce by the formation of 4 basidiospores on each terminal sterigmata. Chroococus is sometimes replaced by filamentons Blue, green alga Scytonema.

Generally lichens are very varied and abundant in tropics. In India-Awasthi (1965) has enlisted 1310 species spread over 158 genera. The variety of terrain, variation in climate and humidity have greatly favoured the formation of various lichens in India. Those that occur in Western Himalayas are about 30 in the neighbourhood of Mussouri (Quraishi, 1928). They also occur in Pulney hills (Choisy, 1931). He added 2 new genera and 3 species. Those in Himalayas are described by Chopra (1934), and also those in Vajiristan collected by Blatter. There are 80 species, 38 genera of Ascolichens (Biswas and Awasthi 1948). Later workers have however added many more. In 1961, Awasthi studied the lichens both in field and herbaria and has enumerated many more in his Catalogue of Indian Lichens (1965). So did Ajit-Singh (1964). He enumerates 946 species and 143 genera.

The study of lichens is important from various points of view. They contain lichenic acids, and have medicinal properties. A number of them have been chemically investigated by the late Dr. Sheshadri and his school. Their history is given by Ajit Singh (1964), Awasthi (1965). Hale. Patwardhan et. al (1971-1973) are writing a series of articles on lichens of Western Ghats and Peninsular India. According to Awasthi (1965) 1310 species of lichens are distributed over 158 genera in India. This is a very small number as compared to the size of a country like India and the variety of situations in which they can grow here. The main families represented in Maharashtra are Arthoniaccae, Thelotremaceae. Lecideaceae, Graphidaceae, Lecanoraeae, Parmeliaceae, Pertusariaceae Physciaceae, Teloschistaceae, Usneaceae. Thirteen genera and 29 species of lichens were estimated in Western India upto The largest family is the Physciaceae. The further addition are many: Hale, Patwardhan and their associates.

Since the Maharashtra State is vast and has high hill stations with high humidity variety of climatic zones, these numbers cannot be taken as final. The largest number of species occur at Khandala, Mahabaleshwar, Matheran. Castle Rock and in parts of Melghat and such other places. They are being studied by P. G. Patwardhan and his associates.

From the view point of biochemistry, lichens these days are getting important. They can be classified chemotaxonomically.

Many species of lichens are used for the production of dye-stuffs like Orchil which contain the colouring matter orcein. It is used in dyeing brown and buff colours on wool and silk. Lecanora and Rocella species are mainly used for it. The lichens Rocella montagnei, contains (i) Erythrin and erythrotol, besides small quantities of free orcinol, (ii) Lecanoric acid, eruthritol and rocellic acid and small quantities of free orcinol, (iii) Montagnitol, orcinol, erythritol and rocellic acid.

It has now been found that the newly discovered compound, montagnitol is a derivative of orcinol and promises to be a source of orcinol, being rich in it. Parmellia abessirica from Bellary and Cuddapah districts in South India contains lecanoric acid 3.3% and atranorin 1.1%.

By a modification of the process adopted for the preparation of orchil, the colouring matter contained in the commercial samples of litmus, is obtained. An estimation of the orcinol content in two lichens by the Remann method gave the following values.

Rocella montagnei .. 3.4%
Parmelia abessinica .. 3.1%

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The main genera investigated by Dr. Sheshadri's school are Parmelia, Ramalina, Usnea, Rocella, Thelotrema. The lichen Dermatocarpon moulinsii (Mont.) Zahlbr., gave amino acids.

DISTRIBUTION OF LICHENS IN INDIA

In the Catalogue of Lichens of India by Awasthi (1965) nearly 1310 lichens have been enlisted. A perusal of his list shows only one or two Lichens of Western Ghats and a few more from Peninsular India. The rest are from Eastern, Central and North-west Himalayas, where they have optimum conditions for their growth. Indo-ganga plain is mostly devoid of lichens. Since the distribution of lichens at several places is vet to be known, it is difficult to comment upon the phytogeographical distribution of lichens in India as a whole. In the Eastern Himalayas there is a high correlation between the Lichen flora and the flora of The Eastern Himalayan lichens show higher plants. with the Sino-Japanese lichens and with South East Asian elements e.g., Alectoria asiatica Du Rietz., Parmelia species, Ramalina sinensis Jatta, Usnea asahineae Mot. etc. The lichens from the Western Himalayas show close relationship with the European element e.g. Cetrgria pinastri (Scop.) Rohl, Lobaria, discolor (Bory) Hue. etc. Some lichens like Parmelia cirrhata F. P., Picnospersa tincotrum Tayl. Physcia setosa (Ach.) Nyl. are cosmopolitan having circumpolar distribution. Some are also endemic.

Lichens in the foot-hills of the Himalayas exhibit affinities with the lichens of Tropical Asia and South-East Asia. Some species of Physcia aegialita (Ach.) Nyl., P. picta (SW) Nyl., Pyxine berteriana (Fee.), Imshaug., P. cocoes (SW) Nyl., P. sorediata (Ach.) Mont. Rocella montagnei Bel., are typical examples. Most of these are foliose and fruiticose lichens. The Crustose lichens are restricted to extreme xeric conditions. Foliose lichens are not many. As the lichens occur in isolated ecological nitches in the sholas of Peninsular India or in the interior mountainous regions of Maharashtra, some species are expected to be endemic.

4. BIOCHEMISTRY AND CULTURE OF LICHENS

Patwardhan and Hale are studying lichens to characterize them chemotaxonomically. Biochemistry of lichens has been studied by Asahima and Shibata (1954), Hale (1961) Sheshadri and his associates. Ahmedjian (1967) has studied respiration, resistance to temperatures, CO₂ absorption in lichens and has developed culture methods to isolate components. Lichens contain lichenic acids, polyphenols, vitamin C and even antibiotics. They are known for aromatic substances, particularly the Foliaceous cnes. In India the use of *Parmelia* species as spice is known since long.

Hale (1961) has given account of basic nature and physiology of lichens. Other references on chemistry of lichens are Smith A. 1921. Lichens Camb. Univ. Publ. pp. 464. Shibata, S. Lichen substances in "Methods of plant analysis", 1963. 6: 155-193. Publ. Springer Verlag, Berlin. Smith, D. C. 1963. Biology of Lichen Bot. Rev. 37: 537-570, 1960. Studies in the physiology of Lichen.

Ann. Bot. 24: 186-199.

For work on the Chemistry of Indian lichens refer to Dr. Sheshadri and his associates in Wealth of India, Vol. 6: pp-82-90.

5. COMPONENT GENERA OF ALGAE PARTICIPATING AS PRIMARY SYMBIONTS IN LICHEN ASSOCIATION (After Ahmedjian, 1952, 1958, 1967).

The principal members belong to families Chlorophyceae, Cyanophyceae and Xanthophyceae. The list of Chlorophyceae and their symbiotic lichen association is given separately against the name of a genus in the Table No. II-26.

The principal genera concerned are :-

Chlorella, Gloeocystis, Pseudochlorella, Hyalococcus, Cephaleuros, Cephaleura, Pleurococcus, Stichococcus, Trentepohlia, all belonging to Chlorophyceae.

Hyella, Calothrix, Nostoc, Scytonema, Stigonema belong to Cyanophyceae.

Heterococcus belongs to Xanthophyceae.

The common lichen genera with symbiotic members belonging to Chlorophyceae as the partners are Calycium, Cyalecta, Dermatocarpon, Sarcogyne, Verrucaria, Lacidea, Physcia, Polyblastia, Peltigera, Solorina, Coniocybe, Lepraria, Opegraphia, Pyrenula. They are very common symbionts in tropics and subtropics.

Cyanophytic algae are found in the following lichen genera:

Orthopyrenula, Porosyphus, Placynthium, Colluma, Leptogeum, Pannaria, Peltigera, Lichenothrix, Thermutis, Lichenodium, Soilonema Entebe and Verrulcena.

Heterococcus belonging to Xanthophyceae is found in Monocilia. Many lichens are frequently found in Konkan at places like Sasavane; Bhimashankar, Kodgaon, Castlerock, Anamod, Kodaikanal and in Coorg. They are being studied by Dr. Patwardhan and their associates at the Maharashtra Association for the Cultivation of Science, Pune, and in the Department of Lichenology, Smithsonian Institute at Washington by Dr. Hale and his associates.

TABLE No. II-26

6. List of Algae Names reported as Lichen Symbionts (After Ahmedjian 1952)

Anabaena .. Reported in cephalodia of Stereocaulon-Aphanocapsa ٠. . . haumanianum Duvign. Calothrix ... Cephaleuros . . Chlamydomonas Found in an unlichenized association with the ascomycetous fungus *Humaria*. Chlorella Chlorellopsis . . Chlorosarcina . . Chroococcus Syn. Trentepohlia Chroolepus Reported as symbiont of Racodium rupestre Cladophora • •

and Blodgettia confervoides Hary.

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Coccobotrys

a			
Coccomyxa	• •	Sun Trohousia	
Cystocoecus	• •	Syn, Trebouxia.	
Dactylococcus	• •	Occurring in Psoroma.	- do
Desmococcus	••	Occur in Thelidium hospitum and E carpon pusillum.	:ли 0-
Dichothrix	• •	G. Catalana and	
Diplosphaera	• •	Syn. Stichococcus.	
Gloeocapsa	• •	The state of the Combaladia of Landi	
Gloeocystis	••	Reported in Cephalodia of Lepoli coccophorus and in Lecidea uligin	
Gloeotheca	• •	••	
Gongrosira	• •	a re di-	
Heterococcus	• •	Syn. Monocilia.	
Heterothallus	• •	A sub-genus of Trentepohlia.	
Hyalococcus	• •	••	
Hyella		••	
Jaaqia		••	
Leptosira	• •	~ F363~	
Lyngbya	••	Reported in Cephalodia of Stereocar ramulosum and mixed with Scytone	ulon rma,
Mastigocoleus		In Arthopyrenia sublitorelis.	
Microcystis		In Arthopyrenia.	
Mycoidea		Syn. Cephaleuros.	
Myrmecia		12/1/2/2	
Nostoc		C. Maria	
Palmella			
Phycopeltis		050-308-22/4-2	
Phyllactidium	• •	Syn. Phycopeltis.	
Physolinum		••	
Pleurococcus	••	••	
Polycoccus			
- T	• •	Syn. Microcystis.	
Polycystis Prasiola	• •	·	
Protococcus	••	Syn, Pleurococcus.	
	••	Syn. Pieurococcus In Arthopyrenia sublitoralis.	
Pseudopleurococo	cus	In Arthopyrenia subinorans.	
Rivularia	• •	••	
Scytonema	• •	Com Calmananan	
Sirosiphon	• •	Syn. Stigonema.	
Stichococcus	• •	••	
Stigonema	••	••	
Trebouxia	• •	••	
Trentepohlia	• •	••	
Trochiscia		••	
Urococcus	••	In Cephalodia of Lepolichen coccop	hor
Xanthocapsa	• •	Syn. Gloeocapsa.	

7. LICHENS IN MAHARASHTRA AND WESTERN INDIA

Locality

1.	Pyxine	endoleuca	(Mull.	Arg.)	Around Pune.
	Vuin				

- 2. Parmelia wallichiana Tayl .. Mahabaleshwar-Wilson and Lodwick Points, Bhimashankar.
- 3. Anaptychia podocarpa (Bel) Mass Mahabaleshwar, Bhimashankar.
- 4. Anaptychia diademata (Tayl) .. Mahabaleshwar, Sinhagad, Bhimashankar, Purandar, Khandala.
- 5. Usnea cineraria Mot. Lich. Gen. Mahabaleshwar, Bhimashankar.
- 6. Lecanora chlorona (Ach.) Nyl. Pune.
- 7. Lecanora allophana (wahlb) Mahabaleshwar. Rohl.
- 8. Lecidea parasema Ach. .. Mahabaleshwar.
- 9. Graphis verminosa Mull. Arg. Mahabaleshwar, Khandala, Matheran, Bhimashankar.
- 10. Pertusaria pertusa (L.) Tuch. .. Khandala, Lonavale, Mahabale-shwar.
- 11. Graphina obtecta (Nyl.) Mull. Matheran, Bhimashankar, Arg. Khandala.
- 12. Graphis scripta (L.) Ach. ... Konkan.
- 13. Glyphis cicatricosa Ach. . . Konkan, Goa.
- 14. Phaeographina caesiopruinosa Castlerock, Anamod. (Fee) Mull-Arg.
- 15. Lecidea granifera (Ach.) Vain. Castlerock, Anamod.
- Bacidia fuscorubella (Hoffm.) Castlerock, Anamod. Bausch.
- 17. Bombyliospora domingensis Allapalli forests, Chandrapur. (Pers.) Zahlir.
- 18. Lopadium leucoxanthoides (Vain.) Castlerock, Anamod (Karnatak Zahlbr. State).
- 19. Buellia leptocline (Flot.) Corb. Fergusson College, Hill, Pune.
- 20. Buellia disciformis (Fr.) Mudd. Kolgaon-Sasawane.
- 21. Ochrolechia subpellescens Vers. Mercara.
- 22. Diploschistes scruposus (Schreb.) Purandar.
- 23. Graphina poitiaei (Fee) Mull .. Mercara Forest (Coorg, Karnatak State).
- 24. Graphina acharii (Fee) Mull Yellapur (Karnatak State).
 Arg.
- 25. Sarcographa labyrinthica (Ach.) Mercara Forest (Coorg).
 Mull.
- 26. Coloplaca ferruginea (Hudsth) Kolgaon, Sasawane (Konkan)
- 27. Pyrenula Pinguis Fee ... Castlerock, Anamod.
- 28. Pseudopyrenula pupula (Ach.) Mercara Forest (Coorg). Mull. Arg.

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- 29. Graphis duplicata Ach. .. Bhimashankar
- 30. Pertusaria leioplacella Nyl. .. Kolgaon, Sasawane.
- 31. Catillaria leptocheiloides (Nyl.) Castlerock, Anamod. Zahlbr.
- 32. Arthonia einnabarina (DC) Mercara Forest (Coorg), Wallr.

N.B.—All tables and lists have been compiled from various sources.

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सद्यमेव जयते

CHAPTER III

BRYOPHYTA OR HEPATICOPSIDA AND BRYOPSIDA (Liverworts and Mosses)

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BRYOPHYTA OR HEPATICOPSIDA AND BRYOPSIDA

(Liverworts and Mosses)

Bryophyta as generally understood consist of Liverworts and Mosses. They are also known as Hepaticaceae and Musci, respectively. They form a large group having 960 genera and 24,000 species. Of these liverworts or Hepaticaceae constitute 280 genera and 9,500 species; the rest belong to Musci. Liverworts from many parts of India and the world are yet to be known, especially the Western and Eastern Ghats, Central and North Eastern Himalayan region of India, Java, Australia etc. Therefore, these numbers are bound to be changed.

Both liverworts and mosses are homosporous and have been classified variously by different authors. They are now recognised as Hepaticopsida and Bryopsida by modern authors such as Engler, Melchoir and Wedermann (1954). Their earlier classification as given by Cavers (1911), Stepheni (1912-1917), Campbell (1918), Kashyap (1929)—Goebel (1930), Kashyap and Chopra (1932), Verdoorn (1932), Smith (1955), Prauskaur (1957), Schuuster (1958) and Engler, Merichoir and Wedermann (1954), Parihar (1965) etc differs in point of classes; sub-classes, Orders and families. Naturally, the systematic position of individual family or members is different in their systems. We shall however consider their taxonomic grouping (irrespective of their status) as given below:

HEPATICOPSIDA

Order 1 .. SPHAEROCARPALES

Family .. Sphaerocarpaceae

Order 2 ... RICCIALES
Family ... Ricciaceae

Order 3 .. MARCHANTIALES

Family .. Marchantiaceae

Order 4 .. JUNGERMANNIALES

Sub-order .. Haplomitrineae-Not found in Maharashtra

Sub-order .. Jungermannineae (Acrogynae).

Genera: Frullania, Lejeunea, Radula, Leptocolea,

Sub-order .. Metzgerineae (Anacrogynae)

Genera: Fossombronia, Aneura or Riccardia,

Pallavicinia, Metzgeria.

Order 5 .. ANTHOCEROTALES

Family .. Anthocerotaceae
Order 6 .. CALOBRYALES
Order .. TAKAKIALES

The last two Orders.—CALOBRYALES and TAKAKIALES have been left out of detailed consideration as they are very rare and are known only from Eastern Himalayas in India discovered by Ram Udar and Chandra (1961-1965). Similary the Australian genus Monoclea

not found in India, is sometimes treated as a distinct Order Monocleales. It also is not considered here. All the three liverworts are important from the evolutionary point of view. The commonly represented families in Maharashtra are Ricciaceae, Marchantiaceae, Jungermannieae leafy and fleshy, and the Anthocerotaceae. The number of genera and species under each are shown against their names in bracket. We have, not considered much the Sphaeroearpales as the only representative genus of it is Reilla found in Gujarat, but not in Maharashtra.

The classification of Musci-mosses or Bryopsida adopted here is that of Dickson (1932) and Bruhl (1931) as given in his *Census of Indian Mosses*. Both these groups have recently been studied and revised by Chopra (1974), Gangulee (1962), Steere (1958) and Dabhade (1974).

Liverworts and Mosses are very small non-vascular plants, but they constitute an important step in the evolution of land plants (Campbell, 1908; Bower, 1908, 1935). They all have ended blindly due to their inability to develop effective means of absorbing water, transportation of food from soil under sub-aerial conditions on the land and possibly due to lack of heterospory. They all belong to the gametophytic or haploid generation.

A complete survey of Liverworts and mosses in Maharashtra has not been made. Stray references to them are found in literature and in the papers by Mahabale and his associates, Gorji (1947), Deshpande (1947); Bhate (1945), Raje (1945), Dabhade (1974), and in the papers of Ram Udar (1956-1965), Kashyap (1929), Kashyap and Chopra (1932), Schiffner (1893), Blatter (1929), Dixon (1932), Pande et-al (1954), Bhardwaj (1950-1960), Ram Udar (1970) etc.

The main places from where these plants are generally collected are Mahabaleshwar, Panchgani, Lonavala, Khandala, Matheran, Trimbakeshwar, Bombay, Pune, Nagpur, Melghat and Kinwat. These places except Bombay, Pune and Nagpur are well-known hill stations and receive heavy rains about 400 cm, or more.

The humidity in rainy season is 80—100 % and about 40 % in other seasons. There are enough shady nitches to shelter them in Western Ghats. All these factors are highly conducive for the rich growth of liverworts and mosses, apart from other groups like Fungi, Lichens, and Ferns. About 70 mosses and 25 liverworts are known so far from Maharashtra. Many more would be found by intensive search at several suitable localities.

ORDER 1—SPHAEROCARPALES

Family: Sphaerocarpaceae

As already noted there are no representatives of this Order in Maharashtra, also in many other parts of India. But in the Nal Sarovar on the border of Saurashtra and Gujarat it occurs along or grows on wet mud at the margins of the lake. The only representative of this Order Riella, Riella crossonixa Traul is an aquatic member with two lateral overlapping lobes and a third dorsal lobe arising from the midrib. The life history of this interesting liverwort is worked out by Pande, Misra and Srivastava (1954) for the form called Riella vishwanathii, now considered to be the same as Riella affinis. The genus Sphaerocarpus

is primitive and is supposed to be formed of the prototype of the hypothetical ancestor of the Liverworts called *Sphaero-Riccia*. It has peculiar ovoid bottle-like involucres in which archegonia and antheridia are formed. *Riella* has a distinct twisted midrib. The reproductive organs are borne towards the growing point in the midst of lobes. The life history of *Riella* from Gujarat plant has been worked out by R. G. Patel 1977.

ORDER 2-RICCIALES

Family: Ricciaceae

This family is pretty common in the plains as well in hills at about 2000-3000 ft., but it could be found nearly up to 8000 ft. The genus Riccia is cosmopolitan, growing on moist soils in shady as well as exposed places. There are about 200 species of the genus in the world of which 30 occur in India. The genus is characterised by the absence of air pores and assimilatory chambers. It has spherical embedded sporogoni with a variable number of spores variable between 32-64, very often less. Antheridia are also embedded in thallus in special chambers. The thalli dichotomise once or twice. They could be monoecious or dioecious. The sex however in species has been shown not to be a reliable diagnostic character by Mahabale and Gorii (1947). In Maharashtra, the common species are R discolor L et L, (=R himalayaensis Kash.), R gangetiea Ahmed., now separated from R. himalayaensis in part, R. sanguiena Kash. A winter species found on the river banks. Its thalli look red when mature. R. frostii Aust. considered by some synonymous with this species is found in the ditches along the rivers. It occurs commonly in plains on wet mud along rivers arising in the hilly Maval region of Sahyadris. thallus begins as a male or female, but later the female thalli develop antheridia and become monoccious (Mahabale and Gorji, 1947). The thalli form rosettes, 12-13 mm large, deep green to red in colour. Male thalli are small, 2.5 mm. Sporophytes many, 10 or more, lodged a row within the thallus dorsally. Spores brown, tetrahedral 45-60 mm. in diameter, with irregular reticulations. This species grows along sandy river banks after the floods subside at Nanded, Kopargaon, Pune, Ahmedabad. R. fluitans is a floating aquatic species, generally sterile. It grows in isolated or stagnant pools at high altitude in places like Mahabaleshwar. As the water in ponds dries up, it grows terestrially and produces sporangia.

The thalli of all species dry up in summer but some of them perennate by producing bulbils on the lower side under overlapping protecting scales e. g. in R. discolor. The margins of thalli curl upwards in dry months and are protected by the lateral purple scales. The theoretical importance of this genus lies in the fact that according to Kashyap (1919) and Goebel (1930) it is the last member in the reduction series in the evolution of liverworts starting from the level of Marchantia (See Pande 1932, Mahabale 1942). Its fossil spores have been discovered from the Triassic beds of Scana, Sweden by Miss Lundblad (1954).

Other common bulbiferous species are R. billardieri (= R. himalayensis and R. bulbifera). R. billardieri is a monoecious species with overlapping thalli 3-15 mm × 2.3-2.5 mm, anteriorly sulcate but rather flat dorsally. Its lobes at the apex are pyriform. The ventral scales are semilunar, purple projecting up to margin. The archegonia appear near the midrib and antheridia in front of them in special chambers

or cavities. Sporangia project from the dorsal surface posteriorly on the midline. The spores are dark red or brown 80—150 mm. in diameter, larger than those of R. discolor. They have 5—7 reticulations across the median diameter.

To the above list a new species has been added by Ahmed, R. mangalorica Ahmed, which is better known as R. plana Taylor. Its thalli are grey or light green, densely crowded. The sporophytes project vertically. Spore are pale or dark brown, tetrahedral 85—105 mm. in diameter with 8—10 reticulations on a diameter, spiny, the wing is 5-6. This is a flat species with more or less spongy thallus found on stone walls of bungalows and on compound walls in suburbs of Bombay, where the rainfall is about 90".

The family Ricciaceae comprises three genera monotypic Ricciocarpus natans allied to Riccia fluitans. Both being aquatie, Riccia and Oxymitra Ricciocarpus and Oxymitra are not found in Maharashtra or in other parts of India.

- 1. Riccia billardieri.—The species is bulbiferous in R. billardiari forma bulbifera. It is a monoecious species with overlapping thalli, 3-15 mm × 2.3 mm, anteriorly sulcate, rather flat dorsally. Pyriform tubers appear at the tip. Ventral scales are semilunar, purple, projecting up to margins. Archegoina appear near the midrib in front of the autheridia in special cavities. Sporangia project on the dorsal surface posteriorly on the median line. Spores are red or dark brown, 80—150 mm. in diameter, larger than those in R. discolor. They have 5 to 7 reticulations across their median diameter. Triradiate mark is not prominent; wing absent. It is common on moist ground in August at Powai Lake, National Park, Bombay.
- 2. R. discolor L. et L (R. himalayensis Kash.). This species is dioecious. It has large female thalli, 4-17 mm long; male thalli 3-6 mm. long; tubers apical or lateral. Ventral scales semi-lunar, deep pink, overlapping. Antheridial papillae present on the dorsal surface of the thalli, sulcate along the entire length. Sporogonia project dorsally in median row, spores dark brown 80—120 mm. in diameter with 5-10 reticulations across. Triradiate mark inconspicuous. The species is very common on moist soils at many places.
- 3. R. frostii Aust.—(R. sanquinea Kash.). The species is generally dioecious, but may become monoecious later as shown by Mahabale and Gorji (947). Female thalli 3 mm large, forming rosettes 13-2 mm. large, deep green to red in colour. Male thalli small 2.5 mm, red or pink. Sporophytes numerous in more than one row projecting dorsally. Sipores brown, tetrahedral, 45—60 mm. in diameter, with irregular reticulations; wing entire. This species grows in winter along the river banks after the floods subside, e.g. at Nanded, Kopargaon and Pune on banks of Mutha river.
- 4. R. fluitans L.—This is a floating species having green or yellowish green thalli. It is generally aquatic but when water dries up, it grows on wet mud terestrially. Terestrial form is fertile, Thalli have thin apical lobes. It is 12—15 mm long, 1.5-2 mm broad, with flat dorsal surface. Median ridge is prominent. Air spaces are large, 100—120 mm. long. Thallus is often spongy. Sporophytes lie in a single median

row, projecting ventrally. Spores dark brown, 76-80 mm. in diameter with 4-6 reticulations across. This species is found at *Dhobi* ghat at Mahabaleshwar. It also occurs at higher altitudes elsewhere, but always in isolated ponds.

5. R. plana Taylor (=R. mangalorica Ahmad). Thalli gray or light green, growing densely crowded; dorsal surface concolor. Thalli are very broad. Sporophytes project ventrally. Spores pale brown or dark brown. Tetrahedral 85—105 mm. in diameter with 6-10 mm. reticulations across, spiny, wing 5-6 mm. The species is rather flat, more or less spongy. It grows on stone walls of houses, compounds and bungalows where the rainfall is high, e.g. in Bombay Suburbs.

ORDER 3-MARCHANTIALES

Family-Marchantiaceae

The next Order of liverworts is Marchantiales. It is a large Order comprising 26 genera and about 400 species all over the world. In India 23 genera have been reported. They are generally found at hill stations, but some also occur in plains.

The genus Marchantia does not occur in Maharashtra but is abundant at Panchmadhi, Ootacamund, Srirangpattan etc. The following Marchantiaceous plants are found in Maharashtra:—

1. Asterella angusta Beauv. (Fimbriaria anguata St.):

It is very common in rainy season on the calcareous walls. The thalli 20 mm. x 3 mm, are dioecious and bear sporophytes on upraised archegoniophores on the dorsal surface towards the apical region. Male receptacles are I-cushion-shaped, sessile. They lie dorsally on separate thalli.

2. Plagiochasma L. et L:

An unnamed species similar to Conocephalum is occasionally found in Mahabaleshwar, Melghat; needs investigation. It could be Plagiochasma sp. (?).

- (i) P. appendiculata L. et L.—This is rather uncommon in the State but common at Mount Abu, Panchmadhi etc. It bears stalked male and female receptacles separately but on the same plant. Female receptacle lies generally behind the apex of the thallus, and behind it lie on the same thallus male receptacles as upraised v-cushions Sporophyte round. Spores yellowish, 52—90 mm. with reculate lamellae, 2-3 across a diameter.
- (ii) P. articulatum Kash.—The thallus in this species grows in a continuous articulate manner, becoming progressively smaller towards growing point. Thalli are semilunar each arising from the apex of the lobe one behind. Apex is notched. They are monoecious and bear sessile upraised male receptacles and surrounded by small scales behind the female receptacles raised on stalks at the articutation. This species is very abundant at Panchgani and other hill stations in the Western ghats. Spores are yellowish, reticulate, lamellate, 60—80 mm. in diameter including the wings.
- (iii) P. simlensis Kash.—This species occurs in low hills between Pune and Mahabaleshwar where it is sterile. It has thicker, 15 mm long and 4 mm broad thalli, but most of them are sterile. However in Melghat they are common and fertile. This species reaches its extreme southerly limit in Kodiakanal. It is quite common in N. W. Himalayas, Simla and Nepal, and is also found in Vindhyas at several places.

3. Targionia L. Targionia hypophylla L:

This common liverwort is found at many places. It has peculiar habit of burying the soil apical sporophyte—which is like a small button. Hence the specific name. It is produced near apex of the thallus and is covered by overlapping pink scales. The thallus is 10—15 mm. long and 2—4 mm. broad. It may be monoecious or dioecious. Apex of thallus seldom dichotomises. The pale green thalli occur singly. Antheridia are borne on adventitious lateral branches arising ventrally from thick midrib. Female receptacle is borne near the apex but soon turns down and becomes hypophyllous. Antheridia aggregate on short ventral shoots. There are 5-6 mm. archegonia on each thallus. Spherical capsule is geophilous. Spres 30-40 mm. elaters are prominent, large 140—180 mm. It generally grows in moist shady places. It has deep green overlapping thalli stuck to soil by the base only. It is very common at hill stations such as Mahabaleshwar, Panchgani, Bombay hills, Khandala, Melghat etc.

4. Cyathodium Kunze:

Cyathodium is a small genus generally growing in caves and shady tunnels. Thalli very thin, transparent, yellowish green in colur. C. tuberosum Kashyap and C. barodae Chavan are two common species.

- (i) Cyathodium tuberosum Kash.—The species is dioecious dichotomising once or twice. The thalli are very thin, and have highly overlapping hyaline scales; lobes oblong; male plants less branched; female plants linear oblong, fan-shaped with upraised margins; the dorsal surface flat. Ripe sporogonia are prominent on the thallus. Male receptacles lateral and cushion-shaped. Spores 40 mm. in diameter, elaters spiny, 17 to 30 mm, trispiral. Vegetative propagation is common by means of tubers which arise apically or from any portion of the midrib on the lower side.
- (ii) Cyathodium barodae Chavan.—This is also common in some plains in shade or in open areas especially at Mahabaleshwar, Baroda and elsewhere. The name is given by Prof. A. R. Chavan (1937) who first described it from Baroda. The species grows on the brick and concrete walls with mosses, Riccia and Notothylas, exposed only sometime to sunshine on eastern side, but grows in shaded areas. The plants are delicate, yellowish green, 3-5 mm up to 10 mm, very thin with simple thalius. Air chambers prominent. Adventitious branches are not found in this species as in C. tuberosum. Antheridial receptacles lie near the margin on any part of thallus, but close to the archegoinal receptacle. Sporogonia 0.5—0.70 mm. long. Spores dark brown, spiny 48 mm. long. Elaters 9-10 mm. in a capsule, trispiral. According to Schiffner ex. Proskauer (1951) this species is Synonymous with C. smaragdinum. Recently Ram Udar has found another species of Cyathodium from Mahabaleshwar.

5. Exormotheca Mitten:

(i) Exormotheca tuberifera Kash.—This species is monoecious, but other species of it may be dioecious. It produces short thin tubers from the apex towards the end of rainy season and is propagated by them. The growing plant and tubers are surrounded by minute purple scales. The tuber is full of starch. The thalli dichotomise twice or thrice, Lobes are long, linear, firmly attached to the substratum, 12 mm, green with

deep narrow conspicuous dorsal groove. Ventral surface covered with purple or hyline truncate sulcate scales. Antheridia lie in depression behind the stalk of the female receptacle along the midrib in the median groove. Antheridial papillae are red. Female receptacle arises from a pit at the fork of two lobes. The stalk is 10 mm long. The receptacle hemispherical; capsule is fully exerted, directed upwards. Spores tetrahedral with conical papillae on the convex side. Elaters 120—140mm. with 3 or 4 spirals.

This species grows in dry situations on the slopes of rocks near water falls and in the crevices of rocks. It grows in rainy season and aestivates in dry months, but regenerates again next rainy season by means of tubers. So far it has been known from Katraj near Pune, Sinhagad and Mahabaleshwar.

6. Cryptomitrium Austin

(i) Cryptomitrium, himalayensis Kash.—This small yellowish green monoecious liverwort is extremely delicate; lobes 6×6 mm long quadrate, margin irregularly crenate. Female receptacle stalked, one on each lobe of the fork. Stalk deeply grooved, 6-8-ridged. Receptacle thin, sporogonia 1-3; spores brown, 50-60 mm. tetrahedral, broadly reticulate lamellate on the convex side. Receptacle 2-3 mm in diameter, elaters 350-400 mm. long, closely trispiral, generally green in colour. The plant grows in moist places under dense shade of trees. It is reported from Trimbakeshwar near Nasik and from Mahabaleshwar growing on shady hill sides. According to Stephani (1898—1908), this liverwort is often confused with Cyathodium tenerum. At the end of the rainy season apical portion becomes thick and is marked off by the formation of a oncentric purple band on the hinder side. Portion of the thallus beyond it dies and the anterior portion towards apex survives and regenerates into a new plant next season.

ORDER 4-JUNGERMANNIALES

This is the third Order of liverworts. It is closely related to Marchantiales. They are small thalloid plants, leafy, in most members, except in the family Codoniaceae which are fleshy and thallose. They have leafy axis as a rule, but may be absent.

The rhizoids are always smooth-walled. The leaves appear to have been arranged in two lateral rows on the central axis or midrib, but there is always a third row of leaves below the midrib modified into mucilage glands, water glands or amphigastria etc. Capsule is long stalked and dehisces by four valves.

The Jungermanniales are generally classified into 3 families. Haplomitriaceae, Jungermanniaceae and Metzgeriaceae. Haplomitriaceae does not occur in Maharashtra. The plants belonging to other two suborders or families are distinguished by the presence of archegonia at the apex of the thallus or by absence of them, there as: (1) Acrogynae, and (2) Anacrogynae. In the latter, they are borne on the dorsal surface of the prostrate shoot; but the apical cells are not utilized for the production of the archegoina as in the former. There are about 190 genera and 8,000 species in this Order. It is the largest Order among the Hepaticeae.

ACRDGYNAE

Frullania squarrosa Nees (Family-Frullaniaceae):

This is an epiphytic liverwort common at high altitude with considerable rainfall. It has 2-3 forms. The leaves lie in 2 lateral rows on stem; the leaves on lower 3rd row are converted into amphigastria. Archegonia are terminal and clustered. Different authors have reduced different species from various areas to *F. squarrosa*. So far it is known from Khandala and Mahabaleshwar. The plants are dioecjous and epiphytic. Sometimes they grow on soil near tree trunk also.

Lejeunea sp. (Family-Lejeunaceae):

Plants are small dioecious growing on moist rocks, or bark of trees and on decayed leaves in soil. Leafy lobes are overlapping, distichous, oblique, slightly convex on the dorsal side; ovate oblong 0.5×0.3 mm long. Margin is entire. Amphigastria are large compared to stem, suborbicular, flat and with a branch in about 4 pairs. Perianth obovate beak conspicuous. Ventral leaves are with 2 or 3 small keels. Plants produce dark capsules on a short stalk. It is common at Londha, Castle Rock and hill stations adjoining them in Maharashtra.

Leptocolea lanciloba St. (Family-Lejeunaceae):

This is an epiphyllous liverwort found in high humid areas on the leaves of Cinammomum tamala, Syzygium cumini near water falls, or in high shady evergreen forest trees. Many plants grow on the leaves and complete their life cycle on the leaf itself. The plants are minute 2-5 cm long forming dense network on the smooth upper surface of the leaves of host plants. Their lobes are overlapping, succubous, with numerous amphigastria. Plants are monoecious, producing 8-10 autheridia on small lateral branches. Archegonia are borne on the other branches around the axis in the axils of leafy lobes, each bearing a single archegonium. Capsules are borne in the axils of leaves on erect lateral branches. Plants dry up in summer but do not die.

Small multicelled gemmae arise from any cell at the margin of the thallus lobes and produce new plantlets, propagating the species vegetatively (Mahabale, 1970). They grow overlapping each other.

Radula complanata (L) Dum. (Family-Radulaceae):

The gametophytes are very thin, pale, yellowish green or white, attached to the bark of trees like mango and grow with other mosses and liverworts. Stem 2 cm long, with pinnate branches; leaves imbricate, inserted by broad base, spreading, quadrate or suborbicular 0.75×0.5 mm. margin entire, apex round. The gemmae are formed marginally. They are multicellular. The species is found at Khandala and Mahabaleshwar.

ANACROGYNAE

Fossombronia himalayensis Kash (Family Codoniaceae):

This small liverwort has leaves apparently radially arranged. When growing erect it looks like the head of a cauliflower. Plants grow in compact clusters on moist soil in exposed places. Thalli 8 mm, light green in colour. They have elongated axis and midrib on which bilateral leaves converge. Plants arise either from the spores or from tubers. The species is monoecious and protrandrous. The growing point lies

horizontally in the midst of young leaves and is encircled by mucilagenous hairs. Antheridia and achegonia develop acropetally dorsally, singly or in groups. Archegonia generally lie in the immediate vicinity of the growing point. Sporophyte globose, exerted on a transparent short seta, dehiscing by the separation of apical part of the capsule into four valves. Spores 40-50 mm, brown with furcate lamellae, sometimes, with a few reticulations. Elaters loosely bior trispiral, 100—140 mm long. Tubers produced apically are sessile or stalked. It is allied to Sewardiella (See Pande, Mahabale, Raje, and Srivastava 1954) and is found on moist ground in many places.

Petalophyllum Gettsche (Family-Codoniaceae):

Petalophyllum indicum Kashyap.—This is a rare liverwort found only at the citadel of Purandar fort (District Pune). Plants dioecious, 3-4 mm long, 7 mm broad, basal portion cylindrical and winged. Wing manylayered at the base, becoming one-layered anteriorly. Midrib distinct. Antheridia lie in groups behind the apex, covered by scales. Archegonia in groups of 4—7 on the midrib, protected by a bell-shaped perianth. Sporogonia generally one in each perianth. Seta variable in length, 10—25 mm long, capsule spherical, 2 mm in diameter, dark brown. Spores dark brown, round 40 mm in diameter with a wavy margin, reticulate black, with 3—4 pentagonal or hexagonal, reticulations on median diameter, 8-10 mm each. Marginal wing 14-17 mm. Elators 280-400 mm long, 8—10 mm broad, rarely branched, attenuated towards both ends.

Aneura Dum. or Riccardia S. F. Gray (Family-Aneuraceae):

A. indica St. (Ms.).—This liverwort is very common on wet soil in marshy places along puddles, flowing water courses etc. e.g. at Pashan lake near Pune. Plants dioecious. Thallus fleshy, pinnatly branched with a broad midrib. Male plants more thick, less circular; female plants very short at the margin and has short branches in 2—8 series, perianth. absent. Calyptra large, cylindrical having papillae at the apex. Capsule pedicellate, oblong, opening up to base by 4 valves. Spores small, 20—30 mm, lamellate, elators 190 mm. long, monospiral. The species often grow in moist places in small patches usually singly.

Pallavicinia: (Family—Pallaviciniacea):

Pallavicinia longiseta.—Plants dioecious, thalli overlapping, thin, 20—25 mm long, with very distinct midrib and thin wings. Male thalli producing antheridia dorsally on the median line. Female thalli produce archegonia near the apex. Sporophyte has a long transparent seta about 2-3 cm long. Capsule avoid, conical, brown in colour, irregularly formed. Elatophore distinct, spores opaque. This is one of the handsome liverwort supposed to be a prototype of early fossil liverworts especially the Jungermaniales.

Metzgeria Reddi (Family-Metzgeriaceae):

Metzgeria pubescens Reddi.—Plants dioecious, generally sterile forming large interwoven patches on margins of rocks, partially immersed in water and partially outside. Yellowish green upto 50 mm long, 2 mm broad, irregularly branched, distinctly dichotomous. Branches have hairs only on the posterior surface. Branches of female plants have bristles on both surfaces; midrib subterate. Plants often grow without capsule vegetatively. It is common at Castle Rock and adjoining high hilly areas of Maharashtra on wet rocks with trickling water.

ANTHOCEROTOPSIDA

Order: Anthocerotales; (Anthocerotae)

This order comprises highly advanced liverworts popularly known as "Hornworts". They are considered to be an intermediate group between the liverworts and pteridophytes such as Equisetum or Psilophyton But the small number of chromosomes in liverworts and very high number of chromosomes is Equisetum has forced to abandon this once favourite idea. The group is considered to have 6 genera. Anthoceros, Aspiromitus, Phaeoceros, Megaceros, Dendroceros a Malayan genus and Notothylus. Another new genus Folioceros has been added to these by Bharadwaj (1971). Dendroceros and Megaceros do not occur in Maharashtra. The genus Aspiromitus is now considered to be mere section of the large genus of Anthoceros by Proskauer (1951). Bharadwaj (1971 onwards) has published many papers on this group.

There are two types of spores in Anthocarotales and 3 types of elaters. Spores may be black, purple black or yellow. The elaters may be simple, with or without spirals, unicelled or multicelled and septate, single-celled ones may be simple on vermiform. Columella in the sporophyte may be present or absent. They all have Nostoc colonies within the thallus. The new genus Folioceros Bharadwaj (1971) has elaters which are multiseptate unevenly thick walled, beaded, and very distinct and different from those in all other genera of the Anthocerotales.

Anthoceros L.—They have fleshy highly flaccid thalli due to their cells having been filled with mucilage. The species may be monoecious or dioecious.

Anthoceros erectus Kash.—The plants are dioecious growing in dense clusters on damp soil. Thallus thick, fleshy, dark green raised on a thick stalk-like structure, expanding above into a more or less cup-like body, either ascending or prostrate, fan-shaped, deeply lobed, 10 mm, broad male plants, 5 mm, long and 0.8 mm, in diameter. Capsul slender, acute, its wall cells filled with mucilage. Spores black, granulose, 30—40 mm. Pseudo-elaters about 121 mm, thin walled, simple or branched. This species is very common at higher altitudes in the western ghats growing annually.

Besides this species, two or more forms of Aspiromitus dixitianus occur at Khandala.

Anthoceros has two types of spores, some species have black or purple black spores. They are now put under the taxon Anthoceros and the others with yellow spores have been put under a new genus Phaeoceros formed by him. Accordingly Anthoceros himalayensis Kash. with yellow spores has become Phaeoceros himalayensis Praus. The rare genus Aspiromitus has worm-like elaters, generally simple. It is now put under the section black spored species of Anthoceros as a separate section Aspiromitus having vermiform, non-septate elaters (see Mahabale 1941; Prauskaur, 1968; Bharadwaj 1971).

Aspiromitus consists of one or two celled septate vermiform elaters and black spores. Thallus is convernus and has 40 mm. dark echinate purple spores. On account of single unbranched vermiform elaters it is called Aspiromitus. They were segregated by Stephani (1898-1908)

into that genus. Aspiromitus dixitianus Maha, from Khandala was described by Mahabale (1941). It has now been transferred to the dark spored section of Anthoceros, with vermiform elaters called Aspiromitus. It is dioecious. Male thalli 1-1.7 cm long, erect, lobes cunate and furcate, unequal. Male thalli smaller than female thalli bearing numerous antheridia in each chamber 30 or more. Female thalli 2-3 cm long, broad semi-erect, dark green or yellowish green in colour, capsules 1.5-2 mm long, stout, stomatiferous, spores dark black, 40 mm in diameter, claters many, 100-150 mm long, smooth simple 1 or 2 septate, unbranched, deep purple or black in colour. Aspiromitus is very common at Khandala, Reversing station (C-R) Londha, Castle Rock etc.

Phaeoceros:

The yellow spored species of Antheceros now are separated by Proskauer (1951) into a separate genus Phaeoceros. A. himalayensis Kash has become Pheoceros himalayensis (Kash). Pros.

P. himalayensis (Kash.) Proskauer.—Plants dioecious, closely attached to the substrate, light green. They form large patches, thallus linear oblong having tubers at the margin, male plants small, less divided than female plants. Female plants large, circular upto 20 mm in diameter deeply lobed, their margins overlapping, involucre often in pairs, cylindrical, capsule long, 30 mm, not stout, columellate. Spores yellow, tetrahedral, thin, with small rounded papillae on the convex surface 25 mm Pseudoclaters thin-walled, branched or simple 10 mm broad. It grows sparse at Lonavala but is abundant at Mahabaleshwar near Lingmala Falls.

Notothylas.—The genus has about 12 species in temperate and tropical regions. Of these four species N. indica, N. levieri, N. chaudhurii and a yellow spored species of it, reported by Prof. Mrs. Kusum Gupte from Fune, known as N. poonenis Gupte.

The thallus in *Notothylas* is repeatedly divided into a rosette of lobes. Antheridia lie in swollen chambers, 2-4 in each. Involucre short, capsule marginal, conical or spindle shaped, with a large round foot, dehiscing by two valves, stomata absent. Columella present in the centre or may be absent. The capsules fusiform, many, on a thallus. Spores large, tetrahedral with their convex side papillose. Elaters stout, large in size than the spores 30-35 mm. Spores yellow or dark brown or purple; elaters with spiral or simple oblique bands.

N. indica Kash.—It is a columellate species 120 x 18 mm at the median diameter. Spores opaque, dark brown 36mm Pseudo-elaters with bands, 40 mm x 20 mm. This is essentially a species of the plains.

N. levieri Schiff. (M. S.).—This species is noncolumellate, dioecious; plants large, circular in outline, upto 15 mm. Capsule 160 x 10 mm. Spores opaque, dark brown, minutely granulate, 36 mm; sterile cells oblique, curved with thin bands or incomplete spirals. The entire endothecium of it forms archesporium while the whole of amphitheium forms the wall of the Capsule.

N. chaudhurii Nirula.—This species is common on moist ground in rainy season at Nagpur, Yeotmal etc. It is sometimes columellate and sometimes non-columellate as the other species.

Notothylus sp.—Similar to N. poonensis Gupte having yellow spore grows at Dharwar, Kalhattigir (Karnatak) etc. It is a small one growing in rainy season. The thalli are circular monoecious, much lobed at periphery, lobes over-lapping, brown attenuated obliquely towards margin, singly or in pairs. Capsules protrude from the ventral side of the thallus. Spores golden yellow, smooth-walled, 42 u in diameter columlla present; sterile cells not differentiated. Possibly it is a form of N. poonensis.

BRYOPSIDA

Musci or Mosses

The second group of Bryophyta is Musci or mosses. These are small plants having gametophyte in two phases: (1) The algal-like phase protonema, and the second phase, (2) the gameto-phore or the moss plant proper, arising on it as a bud. The plants consist of erect stem with leaf-like organs, the so-called phyllods. It bears gametangia or reproductive organs and then appears sporophyte on it. Musci is a large group of small plants growing either erect or creeping. grow on soil or on trees. Generally a little soil gets collected on bark, the bark gets decomposed and is colonised by Cyanophyceae, Mosses succeeds them and form close stands. They all are homosporus and produce antheridia and archegonia either on the same plant but never together, grow either on separate plants or on different branches of the same plant. Thus they are monoecious or dioecious. In monoecious mosses, the antheridia are formed terminally in large numbers and constitute the so-called moss flower. These then are mixed with sterile multicelled out-growths called paraphyses. Archegonia are borne terminally on separate branches, arising from below the antheridial branch. In dioecious species male and female plants bear either antheridia or archegonia separately.

In some mosses archegonia arise singly in the axils of leaves or lie one below the other acropetally as in *sphagnum*. After fertilization the sporophyte arises as a stalked plant having a bulbous foot, a long stalk or the seta terminating in a capsule. It opens variously by means of an operculum and peristome. Moss capsule is green having photosynthetic tissue and air spaces in it. There is a columella in the middle, around which the spores develop. They are numerous and green or dark brown. There are no elaters in the moss capsule unlike those in the capsule of Hepaticae.

All mosses, like liverworts, are homosporous. There being no heterosporous moss; Spores are liberated periodically by hygroscopic movements of the peristome teeth. And dispersed by wind. On germination they produce alga-like protonema on which the gametophyte arises.

CLASSIFICATION OF MOSSES

There are about 660 genera and 14,500 species. They are generally grouped into three Orders.

- (1) Sphagnales.—These are aquatic mosses growing perpetually from the terminal portion. Their hinder part dies and forms peat; One genus and 336 species;
- (2) Andreaeales.—They grow in extreme xerophytic conditions on hard rocks or in their crevices under hot or cold conditions; 2 genera and 120 species;

- (3) Bryalyes.—This is the largest sub-class of Mosses having 80 families, 675 genera and 14,000 species included in 15 Orders.
- (1) Sphagnales.—These are peculiar mosses growing under water producing thalloid protonema unlike other mosses. They are much branched, erect, with leafy gametophore. It has axillary archegonia and antheridia borne singly in a leaf axil. Sporophyte has an additional false foot below the true bulbous foot, called pseudopodium. Capsule has circumscissile dehiscence and spores are arranged in a crescent shaped cavity, not found in the Maharashtra.
- (2) Andreaeales.—They have creeping protonema and a small oblong capsule breaking ventrally from top. They are also not found in Maharashtra.

Both Sphagnales and Andreaeales are found in the Eastern Himalayas, Assam, in places like Darjeeling, Kalimpong etc.

(3) Bryales.—These have 80 families out of which 25 occur in Maharashtra. The largest family of it has stem with a central conducting column of elongated cells, the Polytrichales. The classification of mosses generally followed is that of Dixon (1932) modified to a small extent by later authors like Bruhl (1931), Brothenus (1924—1928), Steere (1958), Chopra (1974). The following paragraphs give the list of common mosses found in Maharashtra in various habitats. In all about 65 species have been reported. Some of them are highly selective in their substratum and grow as mixed community in which 2 or 3 kinds of mosses grow together or they grow as pure strands of a singly species. The list of moss communities and their growth forms are given below:

Mosses growing gregatiously together are Anoectangium stracheyamum, Anomobryum auratum, Pohlia flexuosa, Bartramidula bartramioides, Bheterophylla, Philonotis sp., P. Sacunda.

Mosses growing in unmixed strands

The mosses given below grow generally in pure unmixed strands: Hyophyla involuta, Hydrogonium consanguineum, Semibarbula orientalis, Physeomitrium, Coorgense, Funaria hygrometrica, F, nutans, Gymnostomiella vermicosa, Splachnobryum indicum, Bryum, coronatum.

Mosses are green, dark pale green or yellowish green in colour and can be recognised by it. They are very often indicative of the substratum on which they grow. Their growth forms are given below.

HABITATWISE CLASSIFICATION OF MOSSES

(A) Mosses growing on humus rich soil:

The following mosses are generally found on humus rich soil more or less acidic e.g. Pogonatum aloides, forma neesii, Fissidens bryoides, Fissidens zollengeri, F. splaerobryoides, Garckea phascoides, Plerochaete squarrosa, Brachymenium acuminatum, Bryum wightii Bartramidula bartramoiodes, Leucodon secundus, Thuidium cymbifolium, Rhyncho stegiella humilis, Vesicularis reticulata.

(B) Mosses growing on forest floor

Following mosses grow on forest floor containing a lot of leaf debris.

Brachymenium exile, Bryum wightii, Diaphanodon procumbens, Petrobryopsis walkeri, Meteriopsis reclinata, Pinnatella calcutensis Symphydon angustus, Entoden sp., Streaophyllum tovoyense, S. anceps, S. lingulatum, Glossadelphus, vivicolor, Bryosedgwickia kirtikarii, Eutropothecium cyperoides, Vesicularia reticulata.

(C) Mosses as indicators of underground deposits

Some mosses are highly indicative of the elements on which they grow; e. g. mosa, Marseva grows on soils above the copper deposits and is indicative of copper in the substratum. Some grow on lateritic soil rich in iron or aluminium. The soils at Khandala, Mahabaleshwar, Panhala, Amba are lateritic, and quite rich in oxides of Aluminium. Pogonotum aloides, forma nessii, Funaria hygrometrica, Brachymenium acuminatum, B. exile, Bryum ghatense grow on lateritic soil and show extreme xerophytic adaptations due to excessive iron in them.

(D) Mosses on peaty soils

Brachymenium turgidium, B. nepalense grow on peaty soils, but not on very acidic soils.

(E) Mosses growing on calcareous soils

The following mosses, on the other hand, are calciferous and prefer alkaline soils e. g. Hydrogonium consanguineum, Semibarbula orientalis, Gymnostomiella vernicosa, Splachnbryum indicum, Bryum coronatum etc.

(F) Mosses growing on exposed rocks and similar dry situations:

A peculiar feature of hill stations like Khandala, Mahabaleshwar, Chikhaldara is that they receive heavy precipitation, in four months from the middle of June to end of October, but for the rest of the year, particularly in summer months there are no rains. The mosses growing on exposed rocks and in ledges get completely dried up. A similar situation exists at many places where mosses grow. In such a place mixed associations of mosses Hyophila involuta, Anomobryum auratum, Pohlia flexuosa Bryum coronatum, B. ghatense, P. secunda, Bertiamirula artramiodes, B. roylei, Philonotis hastata come up. They have varied degrees of tolerance to desiccation. Generally two or three of them grow together in one place.

(G) Mosses of high humid places:

A few grow under conditions in which mangroves grow. The mosses that grow under extremely favourable conditions of high humidity produce bulbils by which they propagate vegetatively. Some of them hang from the branches of trees suspended like festoon chains. This group of mosses growing epiphytically on the bark of trees regenerates quickly with the onset of monsoons with high humidity as in Western ghats; but they get dried up completely after January. They form long, pendulous chains hanging from tall trees and engulf their branches. Sometimes the whole tree looks decorated with mosses such as Diaphanodon procumbens, Materiopsis reclinata, Pinnatella calcuttensis.

Some mosses take their nutrition from the decomposition of bark, e. g. Macromitrium sulcatum, Levierella fabroniacea. Others collect some soil by their entangled rhizoids and grow in it. e.g. Brachymenium turgidum. Some from compact cushions feeding partly on the debris

and partly on soil accumulated on the bank e.g. Octoblephaum albidum, Campylopus goughii etc. No moss was found epiphyllously like some leafy Jungermanniales like Coleolejunea sp. or Leptoeclea lancilobs. Some mosses grow well at a great height of tall trees like Holigarnes grahani, Grevillea robusti, at 10-12 m high e.g. Macromitrium sulcatrem, Pterobryopsis walkeri, Meteoriopsis reclinata, Stereophyllum tavoyensis, S. anceps, S. lingulatum. They were not seen at lower heights on the same trees. A unique moss, Calymperos tortelloides grows on the branches of Mangifera indica, Anacardium occidentale growing by the sea coast at Bombay, Thana, Borivali, Kankeshwar, Uran etc. It also grows on the trunks of palms like Borassus flabellifer Cocos nucifera and Areca catechu. It however, does not grow on the same trees in the ghats or elsewhere away from the sea coast. It propagates by gemma formed at the top of leaves.

(H) Aquatic mosses:

Some mosses grow partially in water or under water attached to rocks below e.g. Fissidens sedwickin, which grows under water in rocky stations at Lingmala, Mahabaleshwar and at Matheran. Fissidens grandiformis, Mnium rostratum also grow in water.

Mosses growing in marshy places.—The following mosses grow in marshy places. Pogonatum aloides forma neesii, Fissidan-splachnobryos ides, F. bryoides F. walkeri. Physometrium coorgense, Funaria (Entosthodon) natans.

(I) Mosses as indicators of high humidity:

A special feature of the climate of Mahabaleshwar is extreme humidity above 90% in rainy season. It is highly conducive to the growth and regeneration of mosses. There are Calymperes thwaitesii Macromitrium sulcatum. Diaphanodon procumbans, Pterobryopsiswalkeri, Meteoriopsis reclinata, Pinnatella calcutensis, Symphyodon angustus, Entodon plicatus, E. prorepens, Levierella fabroniacea Stereophyllum tayoyanse. These mosses indicate high humidity in climate.

(J) Mosses restricted to cold climate at high altitude:

The following species grow at high altitude at Khandala and Mahabaleshwar. They have restricted distribution due to cool climate. They may be taken as indicators of climate at certain altitude in western ghats because they are not found in plains down: e. g. Bryum ghatense, B. wightii, Macromitrium sulcatum, Diaphanodon procumbens, Pterobryopsis walkeri, Pinnatella calcuttensis, Symphydon angustus, Entodon, plicatus, Entodon prorepens, Levierella fabroniacea, Stereophyllum tavoyense, S. anceps, S. liqulatum, etc.

On the other hand, Fissidens splachnobryoides, Fissidens bryoides, F. zollingeri, Octoblepharum albidum, Hyophila involuta Erpodium, mangiferae, Stereophyllum tavoyense. They tolerate varied climatic conditions and are climatically cosmopolitan.

(K) Xerophytlic Mosses:

Funaria hygromectrica, Physeomitri m coorgense, Pogonatum aloides, Semibarbula indica, Hydrogonium consanguineum, Funaria nutans, Bryum ghatense, B. coronatum, Plachaobryum indicum, Gymnostomiella vericosa. These mosses grow under very dry conditions.

(L) Cosmopolitan Mosses:

Species like Funaria hygrometrica, Octoblepharum albidum, Fissidens bryoides, Hyophila involuta, Semibarbula orientalis, Gymnostomiella vernicosa, Bryum argenteum are cosmopolitan. They are found allover the world and they indicate no region, soil or climate. They tolerate a variety of conditions, and therefore, no conclusion can be drawn as regards the habitat of such species.

(M) Endemic mosses:

Pogonatum aloides (Hedw.) P. Sesuv. forma neesii (C. Muell) Gang. a new record from Mahabaleshwar and is endemic. Archidium birmannicum Hitt, ex. Dix. on moist ground at Khandala is a new record. Following terrestrial mosses are new records from Mahabaleshwar having restricted distribution. Archidium indicum C. Muell, Fissidens splanchnobryoides Broth, F. bryoides Hedw., F. curvatoxiphiodes, Pleurachaete squarrosa (Brid.) Lind., Hymenostylium recurvirostre (Hedw) Dix., Hydrogonium consanguineum (Thwait et. Mitt.) Hilp., Semibarbula orientalies (Web.) Wijk. et Marg. Anomobryum surateim (Mitt.) Joeg., Pohlia flexuosa Hesk. Some of the New records of terrestrial mosses at Khandala are Funaria (Entosthodon) natans Mitt., Anoectangium stracheyanum Mitt., Rhynchostegiella humillima (Mitt.) Broth. Epiphytic mosses occurring at Khandala and Mahabaleshwar are as follows:—

Fissidens minatus wait et Mitt Campylopus goughii (Mitt) Jaege Campylopus gracilis (Mill.) Jaeg., Mahabaleshwar are other terrestrial mosses. Brachymenium nepalense. Heok, Bryum ghatense Broth. ex. Dix. Bryum coromatum schwaeger, Bryum argenteum Hedw, Leucodon secundus (Harv.) Mitt., Thuidium cymbifolium Dos. et Molk, Rhynchostegiella humillima (Mitt.) Broth., Entoden prorepens (Mitt.) Jaeg., Glossadelphus urbicolour (Broth. et Dix.) Broth., Bryosedqwickia kiriikarii Card. and Dix. Ectropothecium cyperoides (Hook.) Jaeg are epiphytes at Mahabaleshwar.

The species Poleurochaete squarosa (Brid.) Lindb. Dicranodontium didictyon, Leucodon secundus, Glossadelphzus tolingeri were supposed to be rare but they have been found in Western India now.

A classification of mosses based on ecological considerations has been given by Gams (1932) in Verdoorns *Manual of Bryology* Bt. XII pp. 322—366, 1932 and hence not repeated here.

GEOGRAPHICAL DISTRIBUTION OF MOSSES

In point of geographical distribution some mosses like, Funaria are cosmopolitan. Others have restricted or regional distribution and still others are endemic. The paragraphs below enlist them separately.

Mosses in India are concentrated in four regions viz., Eastern Himalayas, Western Himalayas, Western Ghats and Eastern ghats. A part of Western Ghats are in Maharashtra. Some genera and species extend right down southwards upto Nilgiris and Kodaikanal, and some are concentrated in N.-W. Himalayas and some in Eastern Himalayas. Khandala, Mahabaleshwar in Maharashtra are only typical examples of places where rich moss flora occurs. They need to be surveyed.

Mosses as a class are the only colonisers of land from aquatic habitat. Very few mosses are found in early times. But in quaternary period they are abundant. They are known as *Muscites* and range from upper carboniferous to Pleistocene. Several members of Sphagnales are known to form peat bogs. They are very rare in the Mosozoic period, but some do occur in the Triassic of Natal, Cretaceous of Greenland, North America etc. Some members of Polytrichales are known from the Miocene period and species of *Muscites* from the Oligocene of Victoria, Australia. In many peat deposits they are in the state of imperfect fossilization, but are not fully fossilized. They really are the sub fossils. In Maharashtra there are very few peat bogs and no fossils of mosses have been found in them.

CYTOLOGY AND MOSS POPULATION:

Mosses generally grow in good number of individuals in various popula-Although they look alike morphologically there is a difference in their haploid and dirloid colonies. Mosses are known to have polyploid as well as anupoloid colonies and races with inter and intra specific polyploidy occur, of which intrapolyploidy is more common. abount 12%. The exact status of interspecific polyploidy is difficult to determine. Out of 1120 mosses of which the chromosome numbers are known, 285 mosses have intraspecific polyploidy. The percentage of polyploids is highest in Ukranian region of U.S.S.R. where the highest number of polyploid mosses are known, about 45%. The lowest Lolyploid mosses are found in India. Some specific examples are Entoden 22 and 33, Brachymenium 11 and 22, Tortula 13, 14 and 25, Hyophyla 7 and 13 and Pohlia 11 and 22. Polyploidy is generally brought about by a change in chromosome number and sexuality. There are varied base numbers, 6, 8, 9 in mosses, is common in Indian mosses. The ratio of sexes in mosses is not determined. The haploid mosses are generally dioecious and diploid monoceious. Dioecism is supposed to be due to preferential pairing of sex chromosomes. Polyvalent chromosomes are also known.

Anuploidy occurs in Bryum 10 and 11 Pohlia 22 and 23. It is due to chromosomal fragmentation. The sexuality in moss populations has been studied by Mehra and Khanna (1951). Externally all these populations look morphologically alike and there are no means to recognise them externally e.g. In Hyophila involuta populations, there are 7 and 13 chromosomes. In Pohlia longicola their populations with 11, 20 and 22 hromosomes but externally they all look very much alike. There s a v a t field for cytological investigation of Indian mosses as some of their characters like peristome teeth, their whorls and their evolution etc., are correlated with sexuality and chromosome numbers.

SPECIES OF MOSSES IN MAHARASHTRA

(Compiled with the help of Dabhade, 1974, Brotherus, 1924-28, Bruhl 1931, and Blatter 1929)

Classification followed here is that of Dixon (1932) based on Fleischer (1902-1922), Brotherus (1924-1925) and by R. Van der Wijk and Chopra R. S. 1966 in their Mestographs of the Indian Mosses. C. S. I. R. Publication.

Serial No. Name of Species

Habitat

Family 1. Polytrichaceae:

1 Pogonatum aloides (Hedw) P. Beauv Terrestrial on laterite soil forma neesii (C. Muell) Gong.

Habitat Name of Species Serial No. Family 2. Archidiaceae: 2 Archidium birmannicum Mitt Ex. Dix. Terrestrial on sandy soil 3 Archidium indicum C. Muell Terrestrial on rock Family 3. Fissidentaceae: Terrestrial on laterite soil 4 Fissidens splachnodryoides Broth. 5 Fissidens bryoides Hedw. Terrestrial on laterite soil 6 Fissidens curvatoxiphiaides Dix et Vard Terrestrial on laterite soil Fissidens teniolatus Dix et P. Verd Terrestrial on laterite soil 8 Fissidens minutus Thwait et Mitt. Epiphytic Aquatic on basaltic rocks 9 Fissidens sedgwickii Broth. stones in streams 10 Fissidens walkeri Broth Terrestrial on laterite soil Family 4. Ditrichaceae: Garckea phascoides (Hooki) C.Muell Terrestrial on laterite soil Family 5. Dicranaceae: **Epiphytic** 12 Campylopus gouhghii (Mitt.) Jaeg. Epiphytic 13 Campylopus gracilis (Mitt.) Jaeg. 14 Dicranodontium didictyon (Mitt.) Jaeg. Epiphytic Family 6. Leucobryaceae: 15 Octoblepharum albidum Hedw. Epiphytic Family 7. Pottiaceae: Subfamily-Trichostomoideae: 16 Pleurochaete squarrosa (Brid.) Lindb Terrestrial on sandy soil Subtamily—Fucladioideae Terrestrial on sandy soil Anoectangium strachevanum Mitt. 17 Hymenostyliumrecurvirostre (Hedw.) Terrestrial on basalt rock Dix. Terrestrial on basalt rock 19 Hyophyls involuta (Hook.) Jaeg. Terrestrial on sandy soil 20 Hydrogonium consanguineum (Thwait et Mitt.) Hilp. Semibarbula orientalis (Web.) Wijk Terrestrial calcareous soil 21 et Marg. Family 8. Funariaceae: Terrestrial on sandy soil 22 Physcomitrium coorgense Broth Funaria hygrometrics Hedw. Terrestrial on basalt rock Funaria (Entosthodon) nutans (Mitt.) Terrestrial on sandy soil Broth. 25 Gymnostomiella varnicosa (Hook) Terrestrial on calcareous

Fleissh.

C. Muell.

26 Splachnobryum indicum Hamp, et.

Terrestrial on basalt rock

Serial	No. Name of Species	Habitat
Famil	y 9. Bryaceae:	
27		Terrestrial on basalt rock
28	•	Terrestrial on basalt rock
29		Terrestrial on sandy soil
30	Brachymenium exile (Doz et Molk.) Bosch. et Lac.	Terrestrial on sandy soil
31	Bryum ghatense Broth. ex. Dix.	Terrestrial on basalt rock stone walls.
32	Brachymenium nepalense Hook.	Epiphytic or on rock
33	Brachymenium turgidum Broth. ex Dix.	Epiphytic on tree bark,
. 34	Bryum coronatum Schwaegr	Terrestrial on sandy or Brickwalls.
35	Bryum argenteum Hedw.	Terrestrial on basalt rock
36	Bryum wightii Mitt.	Terrestrial on sandy soil
Famil	y 10. Bartramiaceae:	
37		Terrestrial on sandy soil
38		Terrestrial on sandy soil
39	0.0000000000000000000000000000000000000	Terrestrial
40	Philonotis hastata (Dub.) Wijk, et Marg.	Terrestrial on basalt rock
41	Philonotis secunda (Doz. et Molk.) Bosch. et Lac.	Terrestrial on basalt rock
Fami	ly 11. Erpodiaceae:	/
	Erpodium mangi Ferae C. Muell.	Epiphytic on bark of ban- yan.
Fami	ly 12. Orthotrichaceae:	
43	Macromitrium sulcatum (Hook.) Bird.	Epiphytic on mango bark
Fami	ly 13. Leucodontaceae:	
	Leucodon secundus (Harv.) Mitt.	Terrestrial on sandy soil
Fami	ly 14. Trachypodaceae:	
45	Diaphanodon procumbens (C. Muell.) Ren. et Card.	Epiphytic hanging from branches
Fami	ly 15. Pterobryaceae:	
	Prerobryopsis walkeri (Broth.) Borth	Epiphytic on bark of trees
Fami	ly 16. Meteoriaceae :	
47	·	Epithytic on branches of tress.
Fami	ly 17. Neckeraceae:	
	Pinnatella calcutensis Fleisch,	Epiphytic

Serial No.

Name of Species

Habitat

Family 18. Thuidiaceae:

49 Thuidium cymbifolium Doz. et Molk. Terrestrial on sandy soil

Family 19. Brachytheciaceae:

50 Rhynchostegiella humillima (Mitt.) Terrestrial on sandy soil Broth.

Family 20. Symphyodontaceae:

51 Symphyodon angustus (C. Muell) Epiphytic on tree bark Jaeg.

Family 21. Entodontaceae:

52	Entodon plicatus C. Muell	Terrestrial on moist ground in ghats.
53	Entodo prorepens (Mitt.) Jacg.	Terrestrial on sandy soil
54	Levierella fabroniacea C. Muell	Epiphytic on bark

Family 22. Plagiotheciaceae:

55	Stereophyllum	tavoyense	(Hook)	Epiphytic	on	bark
	Jaeg.	5	dags.	1		

56 Stereophyllumanceps (Bosch.etLec.) Epi'phytic on bark Broth.

57 Stereophyllum ligulatum Jaeg. Epiphytic on bark

Family 23. Sematophyllaceae:

- 58 Glossadelphus vivicolor (Broth, et. Epiphytic on bark Dix.) Broth.
- 59 Glossadelphus zollingeri (C. Muell) Terrestrial on basalt rocks and on stones

Family 24. Hypnaceae:

- 60 Bryosedgwickia kirtikarii Card et Epiphytic on trees Dix.
- 61 Ectropothecium cyperoides (Hook.) Epiphytic on tree bark Jaeg.
- 62 Vesicularia reticulat a (Doz.et. Molk) Terrestrial on sandy soil Broth.

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सन्यमेव जयते

CHAPTER IV

PTEROPSIDA OR VASCULAR CRYPTOGAMS

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CHAPTER IV

PTEROPSIDA

VASCULAR CRYPTOGAMS

PTERIDOPHYTA

Next to Angiosperms is the group of Vascular or higher Cryptogoms. They are a very ancient group known from the Silurian Devonian period to Modern times. Habit and form of many of them have changed through ages. Some of them have even become extinct. Unlike Bryophyta they have vascular elements or vessels in them. They have antheridia and archegonia like Bryophyta; but the structure of archegonium is continued further in Cycads, Ginkgo and Conifers. Hence these groups are sometimes classed as Archegoniatae. They also share another character with higher plants in possessing a concealed embryo, and are, therefore, classed as Embryophyta which includes Bryophyta, Pteridophyta, Gymnosperms and Angiosperms also. It is customary to recognize 4 categories or groups of pteridophytes which are summarized in table No, IV-1.



TABLE No. IV-1
MAIN GROUPS OF LIVING VASCULAR CRYPTOGAME

A-127-17-B.

			SUMMARY C	SUMMARY OF MAIN GROUPS OF LIVING VASCULAR CRYPTOGAMS	IVING VAS	CULAR CRYPTOGAMS			
J	Class	Oreer	Family	Distribution in world	erld	Distribution in India	n India	Distribution i	Distribution in Maharashtra
ļ				Genera	Species	Genera	Species	Genera	Species
٦.	I. Psilopsida	Psilotales	Psilotaceae	Psilotum	717	Psilotum	. 2	-	F
II. Ar	II. Articulatae	Equisetalus	Equisetaceae	I mesipieris Equisetum	4 5	Equisetum		-	2+1
III. Ly	yeopsida	III. Lycopsida Lycopodiales	Lypodiaceae (A) Homosphorae	Lycopodium	180	Lycopodium	. 34	-	2
			(B) Heterosporae Selagiaellaceae Isoetaceae	Selaginella Isoetes	800 70 5	Selaginella Isottes	:: 24,3		10 10
IV. FI	IV. Filicopsida	Filicales (Serics I)	Filicinae Homosporae:	: Samhac					
			(a) Ophiglossa-	Ophiog!ossum Botrychium Halminkostachus	34 43				
			(d) Marattiaceae	7 T	53	Angiopteris Moratia	:	1,	-
		(Series-II)	(c) Osmundace ae Leptosporangiatae	3	8700	Osmunda	· "		•
		The number o	f Homosporous fami	The number of Homosporous families varies according to the classification followed by different authors. It is estimated that there are 605 species of Ferns and Fern allies (500+105) in India.	o the class	ification followed by 0+105) in India.	different auth	loffs.	
		(S. rics-III)	Heterosporae: Marsiliaceae	Marsilia Pilularia	53	Marsılia	10	1	æ
			Salviniaceae	Ragnelidiun Salvinia Azolla	10 6	Salvinia Azolia	::		1

Remarks on the Table :-

- 1. Estimates of total number of genera and species differ much according to the system of classification followed for Filicales: Christansen (1938) gives 247 genera and 9,000 species, Copeland (1947) gives 229 genera, Holttum (1949) gives 300 genera and 10,000 species.
- 2. Osmundaceae is generally treated as a separate order with a single family Osmundaceae and intermediate between Eusphorangiates and Lepto sporangiatae because of marginal tassels, or/and super ficial sporangia on the lower surface of leaf, rudimentary annulus and vertical dehiscence. It has three genera Osmunda having 12 species, Todea, 1, and Leptopteris 6. In India O. regalis; O. cinnemomea and O. claytonia are found; but in Maharashtra only O. regalis occurs. O. cinnamomea grows in NEFA and D. javanica is often cultivated in garden.
- 3. Leptosporangiatae are variously classified into different families and sub-families, but generally 13-15 families are recognized. Of these family polypodiaceae is the largest family comprising 170 genera and about 7,000 species.

Peranema sp. cyathcoides (fam. Dicksoniaceae) like Diacalpe is monotypic.

- 4. Tree ferns do not occur in Maharashtra but occur in neighbouring region of Goa and North Kanara.
- 5. There are 15-17 families of Leptosporangiate ferns in Maharashtra and about 60 species.
- 6. It is estimated that India has, more than 600 species (about 705) of pteridophytes. Of these 105 are fern allies and the rest ferns. Gray (1886) has described 50 species as occurring in Bombay Presidency, and Blatter and d' Almeida (1922) have described 57. The group is badly in need of thorough revision in the light of several modern works.

1. ORDER: PSILOTALES

Family Psilotaceae

This Family of Vascular Cryptogams is represented in the world by only two living genera. In the past they had many representatives, but at present they are survived by 2 genera and 4 species. The first genus Psilotum is more or less cosmopolitan in Tropics, and the second genus Tmesipteris is endemic in Australia and New Zealand. There are only two species of Psilotum, P. nudum (L) Beauy. (=P. triquetum SW.) and P. complanatum SW. They occur in India. Tmesipteris has 2 species, Tmesipteris tannensis Bernh., and Tmesipteris vieillardi Dangeard. They do not occur anywhere in India.

Psilotum nudum grows terrestrially in the crevices of rocks or in walls of wells. It also grows epithetically on Ficus retusa or in the midst of roots of Phoenix sylvestris or Euphorbia sp., But on the whole is very rare plant. It used to occur in a well at Ghodbandar near Bombay. It grows mixed up with the clumps of Euphorbia tridentata. But due to repeated collections by unscrupulous collectors and by students out of curiosity, the plant has nearly disappeared. It was once collected by

Mahabale and Deshpande (1942) at Lonavala (District Pune) growing epiphytically on a tree of *Fucus retusa* on old branches. Presumably it may be found in other places also in high rainfall areas at higher altitude. It is fairly common at Paclamadhi (MP), Castle rock and Dandeli (Karnatak State).

Bierhorst (1971, 1973) regards Psilotum and Tmesipteris as ferns.

2. ORDER: LYCOPODIALES

Family Lycopodiaceae

Lycopodiales like Filicales are a very ancient group and are represented by 2 living genera. In fossils they have several forms, known from Devonian to Jurassic period. In Carboniferous period fossil members had tree habit which they do not possess any longer. In India about 30 species of *Lycopodium* are known of which two occur in Maharashtra and a third one in Mysore Forests.

Lycopodium cernum Linn. is a terrestrial species and occurs in places around Castle Rock, now in North Canara district and in Goa near Collem. The other species is Lycopodium hamiltoni Spring. The third species L. phlegmaria Linn grows very sparingly in thick forests in Mysore and Ooty. L. hamiltoni is epiphytic and is not uncommon at Mahabaleshwar on tall trees in Fitzgerald Ghat, and in the Raiwood near Railway station at Lonavla. It is a small species, 10-15 cms long, having large axillary sporangia towards growing apex as those in L. selago. It has no cones. Reproductive and vegetative zones alternate.

On the other hand, sporangia of *L. cernum* and *L. phlegmaria* occur in terminal portions of branches as spikes and are often dichotomised. They are erect in *L. cernum* and pendulous in *L. phlegmaria* Sporangia of *L. cernum* form terminal cones or spikes at the end of vertical branches, but those of *L. phlegmaria* droop down. The genus obviously is dwindling. Birdwood (1887) in his *Catalogue of Matheran and Mahabaleshwar Plants* has recorded 2 other species of *Lycopodium*. *L. imbricata* Spring and *L. obtusatum* Fairbank, but they have not been found by subsequent authors. Presumably *Selaginella* was mistaken for them.

3. ORDER: EQUISETALES

Family Equisetaceae

Equisetales also are a very ancient group having had many tree-like representatives in the Palaeozoic, especially in the carboniferous period. But its tree-like representatives completely disappeared with the onset of Mesozoic era. In India it has 5 fossil representatives namely Schizoneura gondwanensis Feist; Phyllotheca having 2 species P. indica Burmi; P. Sahnii, Saksena, Stellotheca 1 species. S. robusta Feist., Raniganjia 2 species, R. bengalensis (Feist.) Rigby, R. indica (Strivastava) Rigby and Neocalamites 1 species of a tall bamboo like genus peculiar to southern continents during the Triassic period. Ultimately they all died and were survived by a small reed like plant called Equisetites. It is the nearest relative of the only surviving genus of the family, Equisetum.

Genus-Equisetum

There are thirty-two species of this genus in the world of which 4-5 occur in India. E. debile Roxb. E. ramasissimum Desv., E. arvense Linn., E. diffusum Don Prod., A fifth species E. palustre L. is recently reported from Kashmir. Only two of these species occur in Maharashtra. E. debile Roxb. is a small plant with irregular branches and short internodes, apiculate terminal cones, subtended by a few lower branches, also bearing small terminal cones below the larger cone on the main branch. It has two distinct varieties one is known as E. debile Roxb. proper and the other E. debile var. Pashani Bhide named after Pashan village near Pune where it grows wild and was found first by R. K. Bhide, the famous Herbarium Keeper at the Poona Agricultural College, and a well-known worker on grasses of Bombay. Since the diagnosis of this was not given it is given below:—

Equisetum debile Rox. var. pashani Bhide. Plants generally 15-20 cm. long when it grows near tree, it could be more in length. Stem is 3 mm thick in diameter with 7-14 ridges and furrows. The nodal teeth or scales are small brown or purple, adherent to node. They are not very prominent. Branching is irregular. Some of these branches have small terminal, appiculate cones below the large terminal cone on main stem. Annulus not prominent. Apiculate cones have 30-40 sporangiophores, each having 10-12 sporangia below each peltate hexagonal plate, two at each corner.

Locality: Pashan (Near Pune). This variety is pretty common a Pashan tank near Pune after which it is named. It grows also a Tumuri near Belgaum. E. debile proper is a larger plant 30-40 cm tall, it is common in Punjab on the banks of Ravi river at Lahore, N. W. Himalayas, and regions beyond Afghanistan. Equisetum debile grows on the banks of Godavari river at Kopargaon (Ahmednagar), at Nanded in Marathwada, and at several other places. It grows in Nagpur in the Nag river and forms a bed in Bhima river at Daund, Padegaon, Pandharpur etc.

The second species E. ramosissimum Dave is very widely spread in Madhya Pradesh, Uttar Pradesh, in extra-peninsular India, and in trans-Indus region. It has a large number of varieties all over Europe and Middle East.

4. ORDER: SELAGINELLALES

Family: Selaginellaceae

Genus: Selaginella

Selaginella is a heterosporous member of the Selaginales. It has about 800 species in the world. Alston (1945) has reported 58 species of Selaginella in India, a few more species have been added recently. In Maharashtra the genus is common in Konkan and at all hill stations. It is rare in plains. Five species of it have been reported from Maharashtra.

- 1. S. ciliaris (Retz.) Spring.—This is a very small species hardly 2—6 mm growing generally mixed up with grasses.
- 2. S. miniatospora Baker.—This species 3-5 cm long creeping or erect, restricted to high elevations with high rainfall. Spores are reddish in colour and because of this character it can be easily picked up in field.

3. S. proni flora (Lamk.) Baker (=S. dalzellii Baker, 1885).

This is common in Mahabaleshwar, Ghats, Devimani Ghat and in Malabar. S. reticulata Spring is a small form of S. proni flora. It is a creeping, very delicate species. It has pale green leaves 3-10 mm long on the lower surface. Leaves below the tip of branches are often equal sided, and cordate. It is strongly ciliated. Spikes are terminal, apiculate 1-2 cm long. It grows near wet rocks with tricking water.

- 4. S. tenera (Hook and Grev.) Spring.—This species is common in Konkan, North Canara from Sirsi to Siddapur. It is 12-30 cm long erect, leaves are bright green, suberose. Leaves on the lower plane ascending, contiguous. Those on the side branches, bright green, oblong rhomboida. Those on the upper surface very-small, lanceolate cuspidate spikes are very small 1/10th of a cm in length. The species is very common in Peninsular India and Sri Lanka. It grows abundantly at Ratnagiri.
- 5. S. delicatula (Desv.) Alston S. flaccideum Bory.—This species is common in Konkan, Sawantwadi, Bombay, Lonavla, Pune and Salsette Island etc. It is also found in Coorg, at Yellapore (District North Kanara) Andamans, Nicobars etc. It is a subcrect species with copious pinnate branches, profusely compressed. Leaves on the lower plane ascending, oblong, acute, very small, Iess than 1/10 of a cm. membraneous equal-sided, narrow at the base. Leaves on the upper side still smaller oblong, cuspidate. Spikes copious, slender, 1-3 cm long about 0.5 cm in diameter. It often grows near water courses. Its stem is transparent, pale white and fleshy. It grows during rainy season and no trace of it can be had afterwards. It is found by the side of rocky hill streams at Lonavla.

According to Baker (1897) the genus consists of four sub-genera which comprise several series and groups. In the first subgenus (1) Selaginella proper all ordinary leaves are alike, multifarious; the bracts are uniform. There are 8 species in this subgenus. (2) In the second subgenus Stachygynandrum ordinary leaves are of two kinds, spreading in two planes. Those in the upper plane being more ascending and smaller. This sub-genus has the largest number of species, namely, 250. (3) In the third sub-genus, *Homosathyse* there are two kinds of vegetative leaves spreading in two planes. The bracts also are dimorphous, smaller bracts being in the same plane as the smaller leaves which are more ascending. Only two species were included under this sub-genus by Baker but now only S. pallidissima Spring is retained under this subgenus as S. ciliaris (Retz.) Spring is now generally considered to be the same as S. prolifera Baker; (4) In the fourth sub-genus, Heterostachys there are two kinds of leaves spreading in two different planes. The bracts are resupinate, i.e., smaller bracts in the same plane as that of larger leaves and larger bracts in the same plane as that of the smaller leaves. This subgenus comprises 64 species.

All these subgenera are represented in Indian flora but not all in the flora of Maharashtra. According to Baker (1887) 53 species occur in India of which S. flaccida Spring and S. semicordata Spring and S. radicans Spring and are the same as S. proniflora Baker. It has dwarf variety S. reticulata Spring. S. miniatospora Baker, S. dalzellii Baker S. proniflora Baker and S. tenera occur in the Bombay Presidency. Alston (1945), however, in his recent enumeration of the species has given 58 species in addition to a few of doubtful identity.

Species of Selaginella in Maharashtra.

1. Subgenus Salaginella proper .. Nil.

2. Subgenus Stachygynandrum . = S. delicatula.

= S. flaccida.

= S. radicans.

3. Subgenus Homostachys = S. ciliaris.

4. Subgenus Heterostachys= S. proniflora.

■S. miniatospora.

=S. dalzelli.

= S. itenera.

S. reticulata is a dwarf form of S. prolifera of Baker. But according to Alston (1945) S. ciliaris Spring and S. prolifera Baker are the same.

ORDER: ISOETES

Family Isoetaceae

This Order has only two genera: Cosmopolitan genus Isoetes and the genus Stylites recently discovered by Amstutz in 1957 in Peru (South America). It has two species, Stylites gemmifera Raech and Stylites andicola Amstutz. They seem to be endemic. Unlike Isoetes it has long elongated rhizome. It is not known from any other parts of world and is a link between fossil heterosporous Lycopodiales and living Isoetes. Its sporangia are just like those of Isoetes. They both being heterosporus.

Isoetes:

It is the second heterosporous member of the Lycopodiales. It is represented by about 70 species in the world according Pfeiffer (1922). Only one species of *Isoetes* was known as occurring in India viz. *I. coromandelina L. Isoetes coromandelina* L. It is the oldest known species of the genus from India since the days of Linnaeus. It grows at Panhala (Kolhapur), Lonavla in (Pune) and other places in Sahyadris in Maharashtra.

In 1938 Mahabale found a second species. *I. sahyadri* Maha. growing mixed with a third species *I. dixitii* named by Professor D. V. Shende (1945) at Pachgani, Satara district. Both these species are not widely distributed and often grow isolated in mountain lakes. *I. Sahyadri* has complete velum. *I. dixitii* has no complete velum as in *I. sahyadri*. But it has micro, mega and mixed sporangia having microspores, megaspores and sterile cells.

ORDER: FILICALES

The last order of the living Vascular Cryptogams is Filicales. The Filicales also are an ancient group since the Middle and Upper Devonian period. The plants are highly ornamental and are cultivated in the gardens for the exquisite shapes of their foliage. They are shade and moisture loving plants and grow in forest areas on trees, in marshes,

on moist soils, in crevices of rocks, in ravines and Ghats. They are found at all hill stations. Generally they are confined to high altitude but some are also found in the plains by river side, and even at the sea level in marshes and estuaries. About 305 genera and above 10,000 species of them are known, of which about 200-225 species occur in India. Mostly they are confined to Eastern Himalayas, Sahyadries, Ooty, Eastern and Western Ghats. In Maharashtra about 115 species of ferns spread over 55 genera and 10-15 families, are known.

CLASSIFICATION OF FILICALES

The Ferns or the Filicales are generally classified into two series. Christensen's classification given by Verdoorn (1938) in *Manual of Pteridology* with some modifications made by Holttum (1949) and others is followed here

Series I Eusporangiatae
Series II Leptosporangiatae

SERIES I. EUSPORANGIATAE

A. Ophioglossales Family .. Ophioglossaceae

B. Marattiales Family .. Marattiaceae.

The family Ophioglossaceae consists of three genera Ophioglossum, Botrychium and Helminthostachys which are small fleshy ferns.

The genus Ophioglossum has about 40 species in the world and 10 in India. The only representative of this family in Maharashtra is the genus Ophioglossum having 9 species as listed below. The tenth Indian species O. pendulam L-is a large epiphyte found in Assam and Meghalaya, but nowhere else in India. It also occurs in Sri Lanka.

- 1. O. gramineum willd.
- 2. O. nudicaule L.
- 3. O- flbrosum Schum.
- 4. O. pedunculosum Prantl (sensu non-Desy.)
- 5. O. aitchisonii d' Alm.
- 6. O, reticulatum L.
- 7. O. vulgatum L.
- 8. O. lusitanicum L.
- 9. O. japonicum Prantl.
- 10. O. pendulur. L.

The first 9 species occur in Maharashtra. O. reticulatum L. is the largest, having large cordate conspicuously reticulate leaves with a large, more than 5 cm long spike. The leaves are sometimes 2-3 cm broad, 4 cm long with acute apex, 5-12 cm long, over tapped by a big 2-5 cm apiculate spike. It grows below trees or in midst of grasses. O. aitchinsonii A'Alm, is a hardy, large species with spike arising not at the junction of lamina of leaf and peduncle but the spike arises half way from above the leaf lamina. It is a species of dry gravelly areas growing in the midst of grasses e.g. at Shirur (District Pune). O, fibrosum Schum.

is also a large species having a distinct rhizome similar to shape to that of Amorphophallus and fibrous roots around. It grows in well drained rocky areas with plenty of water. O. vulgatum L. is very rare and doubtfully occurs in Maharashtra. O. japonicum Prantl has ovate elliptical 4.5 cm long, 0.5-0.75 cm broad leaves. It is found on the river banks in alluvial soil. O. lusitanicum L. is very rare and doubtfully occurs in Maharashtra. O. nudicaule L. and O. gramineum Willd. and O. pendunculosum grow in the midst of grasses either on lawns or on the gravel soils. O. gramineum has grass-like leaves 1-3 cm long and 9.2-0.4 cm broad. O. nudicaule has 2 forms one with 1 cm broad ovate, apiculate leaves and another with ovate oblong, slightly smaller leaves. Both occur in the midst of grasses and are highly inconspicuous. Both are very small, hardly 2 cm in height. The peduncle is 2.3 cm. much longer than that in O. gramineum, placed on a small ovate leaf 0.5 cm wide. O. pedunculosum Prantl is a polyphyllous species larger than O. nudicaule L., about 3 cm in height, having ovate lanceolate leaves 1-1.5 cm broad. All these species are ephemeral and generally grow in monsoons; afterwards they aestivate in soil. All of them except O. fibrosum Schum. Propagate vegetatively by underground suckers producing root buds. Sexual reproduction is very rare as the conditions for the formation of prothalli are exceedingly rare and finding prothalli is considered lucky. They are pale yellow, subterranean, mycorhizic and tuberous. They bear more than 100 reproductive organs and are perennial (Mahabale 1939).

The second genus Botrychium has 5-6 species in India, but they do not occur in Maharashtra.

The third genus of the family Ophioglossaceae is *Helminthostachys*. It is a marshy fern. It has rarely been found in this State. It is reported from South Konkan area in marshes of Sawantwadi

The second family of the Eusparangiateae is the Marattiaceae. It comprises genera:

- 1. Angiopteris Hoffm.
- 2. Marattia Sm.
- 3. Kaulfussia Blum.
- 4. Archangiopteris and
- 5. Danea Sm.

Of these Marattia and Angiopteris occur slightly to the south of Maharashtra at Castle Rock and also in South Konkan, Pachmadhi in M.P. Only Angiopteris occurs in Maharashtra, but no locality is known.

SERIES II. LEPTOSPORANGIATAE

The next group or series of Filicales is the Leptosporangiatae. It constitutes the major assemblage of ferns or the Filicales and comprises the following families:

- 1. Osmundaceae.
- 2. Schizaeaceae.
- 3. Marsileaceae.
- 4. Gleicheniaceae.

- 5. Matoniaceae.
- 6. Hymenophyllaceae.
- 7. Cyatheaceae
- 8. Polypodiaceae with its 13 sub-families.
- Dicksoniaceae.
- 10. Parkeriaceae.
- 11. Plagiogyriaceae.
- 12. Loxomaceae.
- 13. Hymenophyllopsidaceae.

Previously it was customary to divide the Filicales into three groups L. Eusporangiatae, Leptosperangiatae and Hydropteridineae. But the Hydropteridineae is a biological group of water ferns, the families Marsiliaceae and Salviniaceae. The Marsiliaceae is supposed to be related to Schizaeaceae and the Salviniaceae to Hymenophyllaceae Cyatheaceae are large tree ferns, Azolla pinnata and Gymnogramme leptophylla are the tiniest ferns of all.

1. Family—Osmundaceae :

One of the most important ancient family of Filicales is the Osmundaceae. It has about 6-8 species, in the world, by far the commonest of them is cosmopolitan species Osmonda regalis L., occurring throughout Peninsular India and elsewhere. It occurs at Mahabaleshwar along some water courses, but it does not grow at other hill stations such as Matheran, Chikhalda etc. O. cinnamomea occurs in NEFA and O. cilaytonia in Kashmir.

2. Family— Schizeaceae:

This family is represented by two wild species of Lygodium L. flexuosum Beed. and L. microphyllum For. A third species L. japonicum Sw. is cultivated. Second genus is Aneimia is commonly cultivated in gardens, especially, the species A. rotundifolia and A. adiantifolia.

3. Family-Marsiliaceae

This is a family of heterosporous ferns. It is supposed to be related to Schizeceae (Bower 1932). It has 3 genera: Marsilea which is a cosmopolitan genus with 30 species in the world, Pilularia with 6 species in temperate countries, and Regnellidium a monotypic genus endemic to Brazil, Cuba and Argentina. R. diphyllum is the only species of it. Marsilea occurs in India, 9 species have been described by Gupta (1962), of which M. aegyptica growing in the deserts of Rajasthan in the bed of Luni River near Jodhpur is very unique inasmuch as, its capsule is compressed in the middle dividing the sporocarp into two parts. The tenth species of India is described by Kolhatkar (1957) under the name M. poonensis Kolhatkar from Pune.

All these genera possess a bean-like or round spore capsule arising from the node or from the base of the petiole, or above the stalk of the petiole. In *Marsilea quadrifolia* the sporocarp is stalked and 3-4 of them arise one above the other on the base of petiole. In *Pilularia* the sporocarp is short stalked one on each, small and round. In *Regnellidium* it is

globular one on each stalk packed with mega—and microspores in verticle compartments. It has two leaves. The structure of sporocarp and mode of germination in each genus are different (Mahabale, 1956).

The plant produces a number of floating leaves on the surface in water, and suckers when trailing on marshy ground. *M. quadrifolia* is the largest in size, petioles long -8-12" and has four teaflets on a petiole; *M. erosa* or *M. minuta* is a small species with 3-4" long petioles. It also produces several stalked sporocarps distinct from the base of petiole at each node. In *M. poonensis* there are 2-3 sporocarps arising separately on stalks from below petiole.

Regnellidium diphyllum is exotic and is now cultivated in Botanical gardens in universities like Lucknow, Pune, Delhi, Dacca etc. Its sporocarp is also stalked, but generally only one arises on each stalk, close to the base of the petiole. It also bears both mega and microspores in compartments in the same sporocarp. A fossil species of a water fern genus related to Regnellidium was found by Dr. Sahni and has been named after Professor K. P. Rode as Rodeites. It is found in the Intertrappean beds of Chhindwada area of Tertiary period.

In Maharashtra *M. quadrifolia* is common in ponds, lakes and riversides. *M. erosa* is found in shallow drying ponds in South Gujarat, Thane and Baroda.

M. poonensis is reported from Pune and vicinity and grows abundantly by the Mutha river. A species named M. konkanensis has been reported by early authors but has not been reported again by anybody so far.

All these species propagate vegetatively as well as by sexual reproduction from spores.

सत्यमेव जयते

4. Gleicheniaceae:

There are 6 genera in this family, but none occur in Maharashtra. G. linearies Bedd. occurs in North Kanara adjacent to Maharashtra and Goa. It is a terrestrial fern with repeatedly dichotomised creeping stem and a dormant bud in the axil of each dichotomy. It has naked groups of sporangia.

5. Family—Matoniaceae:

Matoniaceae are tree ferns mostly from Malaya. They do not occur in Maharashtra but they are found in Sri Lanka (Ceylon), Malaya, Assam etc.

6. Family-Hymenophyllaceae:

The Hymenophyllaceae are filmy ferns belonging to 10 genera. They are represented by 2 genera-Hymenophyllum and Trichomanes. Both are common at Castle Rock but not in Maharashtra except in Sawantwadi region.

7. Family—Cyatheaceae:

These are tree ferns. The family has two genera, Cyathea and Alsophila which modern authors merge into one genus Cyathea. Both grow in North Kanara forests, Pachmadhi etc., but none in Maharashtra.

8. Family—Dicksoniaceae:

Dicksoniaceae are tree ferns with moderate height. Out of 6 genera of it, only one member *Peranema cyatheoides* Don. having 1,2-1.5 cm delicate fronds occurs at Mahabaleshwar in shady places. It has a round sorus raised on a thread like stalk. The family is monotypic and rare.

9. Family-Polypodiaceae:

The family is very large with 13 sub-families. Of these Dennstatioideae and Demnstaedtieae are tree ferns. Plagiogyriaceae do not occur in Maharashtra. The rest have a few members each. Further classification of this family is extremely varied according to views of different authors such as Bower (1926, 1928), Christensen (1938), Ching (1940), Copeland (1947), Holtum (1947) Pichi—Sermoli (1959). The following taxa constituting 13 sub-families are given here. The classification generally followed here is the one followed by Blatter and d'Almeida (1922) and Bower (1926, 1928) with some modifications. We have not included, in the list below, such sub-families as have no representatives in Maharashtra.

Family—Polypodiaceae:

- Sub-family (1) Lindsayoideae
 - (2) Davalliodeae
 - (3) Oleandroideae
 - (4) Pteridoideae
 - (5) Adianteae
 - (6) Cheilanlantheae
 - (7) Blechnoideae
 - (8) Aspleniodeae
 - (9) Theylpteroideae
 - (10) Polypodieae
 - (11) Acrostichoideae
 - (12) Gymnogrammeae
 - (13) Drypteroideae

Family—Parkariaceae.

Family - Plagiogyraceae.

1. Sub-Family-Lindsayoideae:

It has only one genus Schizoloma wild and another cultivated Lindsaya. Lindsaya cultrata Sw. is grown often in gardens. The genus Schizoloma has sori lying on deeply curved lobes.

2. Sub-Family—Davallioideae:

All members of this sub-family have half cup-shaped sori. A species Davallia bullata Wall is reported from the Western Ghats. D. filiensis H. K. is grown in gardens being highly ornamental. Another member of this family is an epithytic creeper, Leucostegia. L. pulcra J. Sm. grows on mango trees at Lonavla and at Mahabaleshwar. Second species L. imersa Presl., grows in the crevices of rocks, or epithylically, in the Ghat section at Mahabaleshwar and Lonavla. The third genus of the family is Microlepia Presl. Species M. speluncae Bedd; is wild and grows at Panhala near Kolhapur and at Pachgani.

3. Sub-Family—Oleandroideae:

A single row of large round sori lying parallel to midrib distinguishes the members of this sub-family. Only one species of the genus Oleandra Kunz. Occurs viz. O. musawefolia Kunz. It is wild at Pachgani.

4. Sub-Family-Pteridoideae:

The sub-family Pteridoideae is a large one, often variously resolved and dissolved from time to time. The marginal sori are linear, fused to make coenosorus. The genus Pteris L. is a large one having about 280 species of which 8 occur in the State. P. longifolia L. now called P. vittata, is wild in many places in dry hills. It is also cultivated in the gardens. P. cretica and Pteris var. albolineata (a horticultural variety), P. ensiformis Burm., P. pellucida Presl are common at Mahabaleshwar Salsette Island, Matheran, Melghat etc., P. quadrinurida Retz. and P. biaurita have several forms. They are very common ferns at Pachgani, Amboli, Khandala, Vetora in Sawantwadi. P. eritica, P. patens and P. wallichiana Ag. are sometimes grown in gardens. P. aquilina L. is both wild and cultivated. It is a weed on cleared waste lands in forests at Mahabaleshwar and other places. Actinopteris dichotoma is a common small palm like fern of dry hills and walls of forts and old fortifications at many places.

5. Sub-Family--Adianteae:

Previously this sub-family was included under Pterideae, but Holttum (1949) proposed a separate family for it on account of its marginal sori distinctly confluent or separate lying under curled leaf lobes. The genus Adiantum has 6-7 wild species and an equal number of cultivated ones. It is a large genus growing pretty wild in wet crevices of rocks. It is often cultivated in gardens for its handsome foliage. About 15 wild and cultivated species of it occur in Maharashtra State. Of these A. lunulatum Burm., A. caudatum L. A. tenerum SW., A. capillus veneris L., grow wild and A. peruvianum Klotzeh., A. trapeziforme L., A. formosum R. Br., A. microphyllum SW., A. aethiopicum L., A. cuneatum Lang. and Fisch. A. gracillimum Moore, A. concinnum H. B. A. collisii Moore, A. hispidulum SW., are the cultivated ones; A. caudatum and A. lunulatum are 'Walking ferns'.

6. Sub-Family—Cheilantheae:

The members of this family have triangular lanceolate bipinnatifid fronds with white rufous or white powder on the lower side of leaf. The margin of pinnules is curved.

The genus Cheilanthes Sw. has three wild species in Maharashtra. C. farinosa Kaulf. grows in open places in forests, on cutting of hills at Mahabaleshwar, Lonavla, Toranmal and other places. C. crysophila is called a 'Golden fern'. Sometimes it is considered only as a variety of C. farinose Kaulf. It has golden yellow rufous or powder on the lower surface of the leaf and hence the name 'Golden fern'. C. albomarginata Clarke has white veins. It is also common at hill stations such as Igatpuri,

Khandala, Matheran, Amboli. It is also referred to as 'Silver fern, C. tenuifolia Sw. is a very small species. It is found at Ravali hill in Bombay Island, but it is more common in the Ghats of Madhya Pradesh in Vindhyas.

7. Sub-Family—Blechnoideae:

It is characterised by sporophylls with coenosori, adherent to the midrib on both sides throughout the length of pinnule. The plants look like small tree ferns. Genus *Blechnum* L. is represented by *B. orientale* L. B. occidentale L. A third species B. volubilis Sw. is sometimes cultivated in gardens.

8. Sub-Family-Asplenioideae:

The taxon Asplenioideae is very large and heterogeneous. It is now split up into many genera other than Asplenium. Its fused sori occur below and above the secondary veins and form linear coenosori. The genus Thamnopteris Presl. has very large fronds. Asplenium has four wild and three cultivated species. The genus Athrium Roth. has three wild species. A. gymnogrammoides Bedd. and A. hookerianum Bedd. are common in hills in rainy season. Another genus Diplaz ium Swartz has three wild species. It is closely related to the genus Anisogonium Presl. A. esculentum Presl. is the only species of it in Maharashtra. It grows wild along the sandy river banks. It is an edible fern. A few sori occur in it on both the sides of tertiary veins. In the genus Athyrium they occur around the tips of veinlets of dichotomised veins.

9. Sub-Family-Thelypterideae:

In this sub-family indusium being absent the sori are naked, more or less round or kidney-shaped, rarely elliptical attached by a central stalk and lodged in small cavities. Fronds are bipinnatifid. The common genera are Thelypteris, Cyclosorus, and Goniopteris Presl. Pleochnemia Presl, Lestrea Presl, Nephrodium Schott and Nephrolepis schott. Of these Pleochnemia, Nephrodium Gymnopteris and Lastrea occur wild.

The genus Gymnopteris Presl is a semi aquatic fern and is also cultivated. Its two wild species are G. presliana Bedd and G. contaminans Bedd. They grow in rocky situations. The genus Pleocnemia Presl has three species two cultivated and one wild P. membranacea Bedd. It grows in monsoon on trees at high altitude. The genus lastrea Hooker, has short stalked, peltate, round sori. It grows on moist rocks and by the sides of hill streams and rivers. In the gardens, however it grows much better and is represented by five or more cultivated species. Nephrodium is a large genus with kidney-shaped, peltate sori. It is represented by nine species. N. molle (—Thelypteris molle desv) is very common throughout India. The related genus Nephrolepis has many cultivated forms and varieties. Six species of it are wild. N. exaltata Schott, is the most common species. N. cordifolia Baker and N. paucirondosa d'Alm are small plants in caves at Pachgani; cultivated N. cordifolia var Duffi is a very large fern with 15.30 cm or more long fronds. It has run wild on the Malabar hill slopes at Bombay.

10. Sub-Family-Polypodiaceae:

The family includes genera like Goniopteris, Phegopteris etc. P. armata Bedd., has very large broad fronds sometimes extending upto 20-25 cm. Goniopteris prolifera Presl. grows profusely near water courses.

but seldom produces sori. The species of Niphobolus Kauf, and N. adanscens Kauf, is a small fern found growing on trees. The genus Pleopeltis H. and B. has large round sori. Its species are often cultivated or may be wild terrestrial or epiphytic, P. linearis Bedd., and P. membranacea Bedd. are common epiphytes on tree trunks and branches in rainy season. Both these species aestivate after rains. Several plants grow on higher branches. Pleopeltis irioides and Pleopeltis phymatodes are cultivated large ferns.

Drynaria quercifolia is an epiphyte on trees in humid forests in ghats and by the side of sea coast in Ratnagiri and Sawantwadi. It has large naked sori and two kinds of leaves, some humus collecting and some photosynthetic. The former are small and fanshaped. It is common in forests at Ratnagiri, Mahabaleshwar etc.. where it sometimes covers all the branches of trees.

11. Sub-Family-Acrostichoideae:

The Sub-Family Acrostichoideae consists of genera Stenoloma J. Sm., Egenolfia, Gymnopteris Presl, and Acrostichum L. Stenoloma palustre Bedd., grows as a climber in forests on tall trees. It climbs almost to the top of trees in Sawantwadi forests and Goa. The genus Gymnopteris is a semi-aquatic fern and is often cultivated. The genus Acrostichum L., species A. aureum L. is a marine mangrove fern. Its fertile leaves are fully studded with golden yellow sporangia on the lower surface. They show what is known as "Acrostichoid distribution of sori" all over the backside of leaf. It grows in tidal backwaters and estuaries as a mangrove in Goa and adjacent places. Egenolfia appendiculata grows in hills at Bhimashankar, Mahabaleshwar etc.

12. Sub-Family-Gymnogrammeae:

The genus Gynnogramme Desv. has two handsome species. One G. leptophylla Desv. grows in the chinks of walls of bungalows at hill stations. It is one of the smallest ferns known. Second G. calomelanos Kaulf. has white powder on the backside of leaves. A variety of it called G. chrysophylla has golden powder on the lower surface of leaves. The silver leaved species G. calomelanos is abundant on Andheri hills (Bombay), Mahabaleshwar etc.

13. Sub-Family—Dryopteroideae:

The family consists of genera Pleopeltis Don., Dryopteris J. Smith., Polystichum Roth., Cyrtomium Presl. The genus Pleopltis Don., has three species, two cultivated and one wild epiphytic, P. membranacea Bedd. The genus Cyrtomium has one species C. falcatum Presl. It is a thick leaved fern with scattered naked sori. It grows wild and is also cultivated in the gardens.

Family—Parkeriaceae (Ceratopterideae):

This is a monogeneric family represented by the single genus Ccratopteris Brong., also called Parkeria. It is separated from Polypodiaceae on account of its dimorphic fronds, acrostichoid distribution of sori, with or without indusium, and spores with highly characteristic ridges on them. Two or three species of it are recognised in the world, but in India and Maharashtra C. thalictroides Brong. only grows. It is common in ponds and marshy places at Khandala, Bombay, Khindsi, etc.

Family-Plagiogyriaceae

Loxomaiceae, Hymenophyllohylaceae do not occur in Maharashtra. Though Hymenophyllum and Trichomanes are said to occur in south Ratnagiri forests on tree trunks.

Family—Salviniaceae:

This is the second family of water ferns allied to Hymenophyllaceae. It is very small family and consists of two genera Salvinia and Azolla. Salvinia does not occur in Maharashtra but is cultivated in tanks. Azolla occurs in tanks, lakes and monsoon ponds. Azolla pinnata is the only species growing in temple ponds, small lakes below Sahyadri ranges. It is found in a temple pond at Ganapatichi Pali in Raigad district, etc. It is pretty common in ponds in Londa and Tinaighat forests in Karnatak. Salvinia has about 10 species and Azolla 6. A fossil species of Azolla is found in the Deccan Intertrappean beds at Sausar near Nagpur, but is different from Azolla pinnata. Salvinia cuculata is cultivated in water reservoirs and also Salvinia auriculata. Both are exotic. Salvinia intertrappea Mahabale is a fossil species found at Mohgaon Kalan, Paradshinga near Nagpur. It is related to Salvinia auriculata of Brazil.

CONCLUSION

On the whole, Maharashtra is quite rich in pteridophytes. There are about 55-60 ferns and 11 non-fern pteridophytes known, so far. Many areas in Chandrapur, Chikhaldara, Melghat, Nagpur, etc., have not been explored, and a fresh search will be rewarding. These areas have also not been explored for Bryophytes (mosses and liverworts).

The names of some ferns in India have been changed. For these recent name changes B. K. Nair and Kaur (1974) be consulted.

Most of the fern families listed above have fossil representatives also which are not considered.

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CHAPTER V—GYMNOSPERMS

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CHAPTER V—GYMNOSPERMS

Gymnosperms constitute a very large assemblage of woody trees; a few are shrubs. They occur in plains as well as in mountains up to tree and snow line. They are of great antiquity. As a matter of fact, more fossil Gymnosperms are known than living ones. Some have living as well as fossil representatives; some are exclusively extinct.

1. LIVING GYMNOSPERMS

The living members of gymnosperms belong to four different orders.

Order	rs	F	umilies	Genera	World species	Species in India	Indigen- ous species in Maha- rashtra
Cycadales			- Mari	9	100	6	0
Ginkgoales		- 6	1		1	0	0
Coniferales	• •	(7	48	520	40	0
Gnetales			3	3	70	5	. 1

2. Fossil Gymnosperms

The fossil members are classified as below, many of them being extinct—

- 2.1. Pteridospermeae or Seed-ferns (Cycado-filicales).—These are a group of small trees of medium height. They have fern-like foliage, foliar sporangia borne on special leaves. But they have no cones.
- 2.2. Cycadeoideae (Bennetitales).—This is a group of trees with leafy sporophylls and has strobili looking like flowers.
- 2.3. Pentoxylales.—These were low shrubs with unilocular terminal sporangia short branches bearing appendages and microsporophylls. They are a unique group discovered in Rajmahal Hills by Professor Birbal Sahni in 1948.

The living members of Gymnosperms are generally grouped as below:—

2.4. Cycadales or Cycads.—This order comprises one family of 9 genera and 100 species, spread in dry tropical desert regions in the Old and New World. Some of them are endemic to Australia (Macrozamia, Bowenia and some Cycas species eg.C.media), South Africa (Stangeria and Eneaphalartos), South America (Zamia), and North America (Microcycas, Dioon and Ccratozamia). In India single genus, namely Cycas occurs of which 6 species are found in mountains, dry regions of Western Ghats, Assam, Sikkim, but none in Maharashtra. It occurs in Karnatak in Nag Mangala area and in Andhra Pradesh on Tirupati hills. They

have male and female plants with huge male cones studded with microsporophylls, and have fern-like pinnate leaves, but no female cones. Megasporophylls are in whorles below growing point of stem.

- 2.5. Coniferales or Conifers.—They have 48 genera and 520 species. They form dominant vegetation up to tree line and some even up to snowline in temperate regions. They are an important source of timber, paper pulp, terpentine and resin. 14 genera and 40 species occur in India. None in Maharashtra. A few are cultivated, e.g. Spp. of Cupressus, Agathis, Tatodium, Podocarpus, Araucaria.
- 2.6. Ginkgoales.—Ginkgoales are represented by a single surviving genus and a single species—not indigenous but cultivated in Asia. The only species G. biloba has leaves which look like those of the fern Adiantum. They have two curly lobes, and hence the species is called biloba. It is a tall deciduous tree. It grows sometimes about 36 metres high. It is called 'Maiden Hair Tree', because of its curly leaves like the curls of a maiden.
- 2.7. Gnetales.—This is a small Order with three odd members Gnetum Ephedra and Welwitschia. Gnetum—is a liana or an under-shrub in Tropical jungles. It has about 34 species. The climbers are 25—40 metres long and shrubs about 5—8 metres high. Only Gnetumula occurs at Khandala and in forests all along Konkan and Malabar.

Ephedra.—This is a leafless desert shrub having about 35 species spread all over the world in sandy desert regions. It is a distinct woody climbing plant having separate male and female plants as in Cycas, Ginkgo or Gnetum. It forms thickets of male and female plants looking like Euphorbia tirucalli. It is distinctly a xerophyte.

Welwitschia.—This is a desert plant of West Africa in the desert region of Congo. It is a unique member having separate male and female plants with two large permanent strap shaped leaves growing continuously with the help of cambium situated at the base of the leaves. Sometimes they reach 6-8 metre length. The leaves are radical and beset on a large tap root. There are hardly 300 plants in the world of this fast dying genus. Some of these are now being cultivated in Portugal to save them.

3. GYMNOSPERMS IN MAHARASHTRA

There are no wild Cycads or Conifers in Maharashtra. No conifers are also found wild, but some are cultivated. However the fossil flora of Wardha-Godavari valley has many fossil coniferous woods belonging to Permian to Jurassic age. In the Quaternary strata and sub-Recent alluvium of the valley of Godavari and Pravara rivers pollen grains of Conifers, especially of Podacarpus are found, suggesting thereby that they were present upto Quaternary period in Maharashtra.

Several Conifers and Cycads however are grown in gardens. The usually cultivated conifers are Cupressus, Thuja, Araucaria and Pinus. Occasionally Taxus, Taxodium Agathis are cultivated in Poona University Botany Department Garden, M. A. C. S. Garden, Pune, etc. Among the Cycads, C. circinalis Linn. C. revoluta Thumb. C. rumphii Mig. are grown for their beauty. In Fergusson College Botanical Garden, Encephalartos sp. and at M. A. C. S. Garden, Zamia floribunda DC are cultivated. Ephedra though does not grow wild in Maharashtra, E. foliata var ciliaris is common in Rajasthan deserts, in Cutch and Saurashtra.

The only gymnosperm wild in Maharashtra is Gnetum ula Brongn. It grows wild at places having high altitude in Western Ghats e. g. at Mahabaleshwar, Khandala, Matheran, Castle Rock, Goa, etc. It also grows near the coastal strips at Janjira, Alibag, etc; nearly at sea level. It continues down right upto Malabar. At Trivendrum in Kerala another species G. contractum Mfg. is found. It is an erect 4-5 ft. tall shrub. On the other hand, Gnetum ula is a huge woody climber producing male and female plants with distinct; strobili in clusters; e.g. at Khandala, Matheran, etc. This rare plant has been conserved because the places where it grows are not easily accessible or because it occurs in Devrai woods where cutting of plants is prohibited. Therefore, this plant has escaped the axe of an indiscriminate woodcutter.

Some efforts to cultivate conifers in Maharashtra are now being made with a fair amount of success. Some species of *Pinus*, *Agathis*, *Cupressus*, *Araucaria* can easily be introduced in the hills at high altitude in Maharashtra. *Agathis australis* and *Pinus longifolia* do well at Panchgani, and *Cupressus* species at Mahabaleshwar, Chikhaldara, etc.

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CHAPTER VI—ANGIOSPERMS: FLORISTIC SURVEY AND ANALYSIS

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CHAPTER VI—ANGIOSPERMS

1. FLORISTIC SURVEY AND ANALYSIS—BOTANICAL REGIONS OF INDIA

Angiosperms or the Flowering plants form the largest and the most conspicuous group of plants in the world. They number about 250,000 having about 300 families and range from the smallest plant like Wolffia measuring hardly 1/10th of a cm to the largest ones like Banyan (Ficus bengalensis) spreading over an acre at Indian Botanical Garden, Calcutta, to the tallest Australian Eucalypti.

They are found from tropics to Sub-arctic region. India has much varied flora and fauna extending from Kashmir to Kanyakumari. It varies from Alpine mountain flora in Kashmir to dry deciduous forests of Peninsular India. There are vast differences in topography, soils and altitudinal heights. Maharashtra lies between 15° 35′ and 22° 2′ North Latitude and 72° 45′ and 80° 35′ East Longitude and has not so much of variation. The highest peak of mountains in it the Sahyadries, is Kalsubai near Igatpuri. It is at an altitude of about 6300′ (1915 mtr.). Naturally there is no Alpine vegetation at such a low height, vegetation like that below the snow line, or that near the timber line. Whatever the differences in the vegetational pattern are there they are due to nearness to sea, or on account of the topography of the table-land of Decean. Much of it lies above the M. S. L. 1200′ to 2000′.

The physical features naturally divide the State into five large natural floral sub-units or zones: (1) Konkan strip adjacent to Arabian sea, (2) Mountainous terrains of Sahyadries or the Ghats region, (3) Desh forming a flat plain to east, with side off-shoots of ranges of Sahyadris (4) Khandesh at the north with low hills of Satpura and (5) Vidarbha including Nagpur, Bhandara, Chandrapur, Ameavati, Akola, Buldhana districts. It receives both the monsoons, South-West and North-East right down upto Alapalli forests in Chandrapur district. This region is cut across by Pench, Wardha, Vainganga and Pranhita rivers and their tributaries.

The difference in the flora of these regions is mainly due to rainfall, temperature, humidity, soils and topography. They are also due to historical reasons as shown later. The plants from the Indoganga plains reach as far south as Khandesh, the Tapti and Narmada basins, and those from Gujarat enter at the North; those from Malabar at the south reach south Konkan and Dangs. The forests of Chandrapur district are adjacent to Andhra Pradesh and Madhya Pradesh, and those in Khandesh are adjacent to South Gujarat and Madhya Pradesh. Naturally the flora gets mixed up in such border regions.

The Maharashtra flora gets further its floristic features due to narrow upland valleys of Maval and Dangs. These are isolated low lying narrow valleys of Sahyadris, and from nitches created by the Sahyadri ranges with their distinct climatic and edaphic factors. Maharashtra once upon a time was a thickly wooded part of 'Dakshina Path' and the Dandakaranya. Only some remnants of them are seen in the flora of Maharashtra. The present flora is successor to the Tertiary flora of Deccan as screened by the successive changes of climate which was dry in Miocene and cold in Pleistocene. The early floras had temperate elements in them, the conifers and members of the Rosaceae. They have disappeared. The present flora of the Desh, Vidarbha and Nagpur region including Chandrapur, is of monsoon deciduous type. The other elements are there, but they do not occupy very large areas.

Hooker (1855) has divided the then British India into 9 botanical regions of which 7th is Sri Lanka and Maldiv Islands, the 8th Burma, and the 9th Malayan Peninsula. They are now different countries. Thus there remain only 6 main botanical divisions of India. Calder (1937) also recognized 6 botanical provinces of India, namely (1) North-Western Himalayas which are rather high and relatively dry, (2) Eastern Himalayas, not so high, but more humid, (3) Indus plain covering Indus basin and the Rajputana desert, (4) Flat Indo-ganga plain formed by the rich alluvium brought down from Himalayas by Ganga, Yamuna and Brahmaputra, (5) The Deccan plateau with a Eastern sub-province the Eastern ghats region in Andhra Pradesh and Orissa and (6) Malabar.

Maharashtra belongs to the 6th division of Hooker (1853) and to the 5th division of Calder (1937). Deobrata Chatterjee (1960) reconsidering the whole position revised these, mainly on the basis of the Endemic Flora which was more or less not known to or fully recognised by Hooker. He divided India into Seven Botanical provinces, except Andamans which forms the 8th separate Botanical province.

Botanical Regions of India according to Hooker (1898), Clarke (1898), Chatterjee (1960) and Calder (1937) are as follows:—

(April 2)								
J	D. Hooker (1898)			C. Calder (1937)	C	C. B. Clarke (1898)	D.	Chatterjee (1957)
	(1)			(2)		(3)		(4)
2.	Western Himalayas,	••	1.	North-Western Himalayas,	Į li.	West Himalayas	8.	Western Himalayas.
3.	Indus Plain		2.	Eastern Himalayas.	. 2.	Indian Desert	3	Indus Plain.
5.	Malabar	••	3.	Indus plain an Rajasthan Des		Malabar	2.	Malabar,
7	Ceylon and Maladiv Islands.	••	4.	Indo-Ganga . Plain.	. 4.	Sri Lanka	1.	Deccan.
6.	Deccan	••	5.	Deccan Plateau with sub-province of Eastern ghats		Coromandalia	4.	Gangetic Plain.
4.	Gangetic plain.	••	6.	Malabar . including Konkan.	. 6.	Gangetic plain	6.	Eastern Himalayas.
1.	Eastern Himalayas.	••		••	., 7.	East Himalayas.	5.	Assam.
8	Burma	••			. 8.	Assam	7.	Central Himalayas.
9.	Malayan Peninsula.	••			. 9.	Ava	9.	Upper Burma.
					10.	Pegu	10.	Lower Burma.
					11.	Malayan Peninsula.		

Hooker (1855) has estimated 17,000 species of flowering plants in British India spread over 170 families, besides 600 species of Ferns and Fern allies. These have been variously estimated by different authors like Santapau (1958), Maheshwari (1965), etc. The Deccan Peninsula of which Maharashtra is a large part is relatively a dry elevated tableland, and it is a part of the most ancient Indian continental land mass the Deccan Peninsula. It has never been under sea and is not affected much by the subsequent changes of terrain due to tectonic movements that took place to its north, elevating the Himalayas, drying up of Tethys, filling up the Indo-gangetic plain by debris from the Himalayas, formation of Indian desert of Rajasthan and Thar Parker etc. The only conspicuous changes in it are due to repeated submergence and elevation of land on its western and eastern coasts—the Arabian sea coast and the Coromandal coast on its east, the sea incursing on the land of Konkan, Saurashtra and Andhra Pradesh more than 2-3 times, and subsequent submergence of West Coast. This has naturally resulted in the climatic changes. The Deccan terrain developed somewhat easterly slope and the rivers therein easterly trend. There is slight elevation towards north. But no great upheavals were there. The flora, therefore, largely remained more or less steady except that some species migrated from one area to another. The temperate species migrated north; and a few Alpine herbs remained confined to high lands of Sahyadris, Vindhyas and the Eastern ghats.

There are no authentic Floras of Madhya Pradesh, Karnatak or the Marathwada region. Some parts of it are now included in Maharashtra. The only authentic work even today is "The Flora of the Bombay Presidency" by Theodore Cooke (1904-1908). He has described 2530 species belonging to 142 families, but this needs revision.

There is no Flora of the Nag-Vidarbha region nor of Marathwada districts. Only some hand lists of Vidarbha region by Witt (1908), Graham (1911), Haines (1912-1914, 1916), Hewstson (1951), Mirashi (1966), Balapure (1960) and the recent Forest Flora of Melghat by Patel (1968) are available. We shall, therefore, consider here such information as is available and base our tentative conclusions on it. But they should not be considered as final and may have to be revised or modified in subsequent years.

Plants of Marathwada have been given in Forest Flora of Hyderabad State by Sharfuddin Khan (1953), by M. Sayeed-ud-din in his various papers, especially in his Presidential address to Botany Section of Science Congress (1954), in Tilak's (1967) Flora of Aurangabad District, and in the List of Herbarium at the Botany Department in Marathwada University (1969), and in papers of Naik (1978). These contain only partial references to them.

2. Constituents of the Flora of Maharashtra

The newly constituted Maharashtra State (1979-80) includes 8 districts of Vidarbha, 5 districts of Marathwada newly added: it excludes the whole of Gujarat, and the districts of Bijapur, Belgaum, Dharwar and North Canara. The Maharashtra flora is heterogeneous in composition. However upto Belgaum and even beyond, in Khandesh, the Deccan traps continue right into Madhya Pradesh and South Gujarat. Therefore, it can be easily divided in sub-regions the Nag-region formed by Nagpur, Bhandara, Chandrapur districts, the plateau of Vidarbha composed by Wardha, Amravati, Yeotmal, Akola and Buldhana districts,

14 districts of Western Maharashtra with high regions of Sahyadri, and the long narrow coastal strip of Konkan. Since the physiography, climate and soil conditions in these different regions are different their flora also differs. Hooker (1855) has put some of them in different botanical provinces. For example, Konkan has been linked with Malabar, Khandesh has been made into a separate sub-unit, and the rest into another botanical province. The reason why Khandesh has been separated as a distinct botanical sub-province is due to its geographical situation. It is lying to the South of Satpudas and is drained by Narmada and Tapi. Similarly Maval is treated as a distinct sub-unit due to its upland valleys and climate therein.

3. PREVIOUS WORK ON BOMBAY PLANTS BY WORKERS BEFORE THEODORE COOKE

The flora of the earstwhile Bombay Presidency has been worked out by several authors and there is quite an amount of information available which Cooke (1908) incorporated into his well-known 'Flora of the Bombay Presidency'. It is still the authoritative Flora of this region, but as it contains plants of Sindh, Gujarat, North Canara, Bijapur, Belgaum and Dharwar and exclude the plants of the five Marathwada districts, it is incomplete and out of date. The figures and conclusions therefore we shall draw will only be tentative. After the publication of Cooke's Flora several papers dealing with the plants of this region by Blatter and his associates, Santapau and his students, G. L. Shah, Mirashi, Razi, Vartak, S. K. Jain, Puri, R. S. Rao, Balapure and others and by the members of Botanical Survey of India have appeared. Even before Cooke, hand lists of Bombay Flora were published by Woodrow, Gammie etc. But more comprehensive than those were two studies by Dalzell and Gibson's 'Bombay Flora' (1861), and the Flowering Plants of Western India by A. K. Nairne (1894). However these had their own limitations and have become outdated.

4. EARLY WORKS ON BOMBAY FLORA

This region of Western India upto Goa has been much explored by various foreign botanists from time to time dating from Garcia de Orta (1563) to Cooke (1908). References to South Konkan Flora were also made by Henrique Van Rheede (1660-1699) in his famous work of the Pre-Linnean period, "Hortus Indicus Malabaricus". Plates illustrating some plants of this region in this work have been included in "Species Plantarum" by Linnaeus (1753). Roxburgh's Flora Indica (1832) also contains references to them. But works on the plants of Vidarbha region are extremely scanty. Graham's (1911) list of 250 plants of Nagpur, and Telankhedi tank is published and the one earlier by Witt (1908). Some workers have been recently collecting and writing stray articles on the plants of that region. Patel (1968) has written "The Forest Flora of Melghat" in District Amravati. It contains short description of 716 plants in the hilly regions of Vidarbha, Melghats and Chikhaldara. The flora of Chandrapur and Akola and other districts are under study by the Botanical Survey of India.

5. FLORA OF OTHER REGIONS IN MAHARASHTRA

Regarding the flora of Marathwada region, a hand list of 679 plants is published by Botany Department of Marathwada University (1974) 'Flora of Aurangabad District' by Tilak (1961) is another work. The flora of Osmanabad district has been worked out by Dr. V. A. Naik but is yet to be published. The late Professor M. Sayeed-ud-din and his

colleagues at the Osmania University have worked on many plants of this region here and there and have described them in their papers. However, there is no account of plants of the hilly region of Ajantha or Kinwat. Sharfuddin (1953) has published a Forest Flora of the Hyderabad State which includes description of the plants from Marathwada districts and also of Telangana not in Maharashtra. We have, therefore, to be satisfied with what little published literature is available.

According to Blatter (1908) there were 2,536 species spread over 142 families in the old Bombay Presidency. This is not a small number as rightly pointed out by Father Blatter (1908) in view of the whole Flora of British India composed of 170 families and 17,000 species. Out of these 142 families in Bombay Presidency, 22 families are having only two genera and 42 families having only one genus. Of these 20 contain only one species each. They are:

•			
1.	Мас	th All	aceae
4.	TATOL	,,,,,,,,,,,	aceae

- 2. Papaveraceae
- 3. Fumaricaceae
- 4. Ancistrocladaceae
- 5. Chailletiaceae
- 6. Ilicaceae
- 7. Sabiaceae
- 8. Saxifragaceae
- 9. Haloragidaceae
- 10. Passifloraceae

- 11. Datiscaceae
- 12. Araliaceae
- 13. Hydrophyllaceae
- 14. Illeceberaceae
- 15. Thymeleaceae
- 16. Elaeagnaceae
- 17. Balanophoraceae
- 18. Ceratophyllaceae
- 19. Xyridaceae
- 20. Flagellarieceae.

The largest families in this region are Leguminoceae and Gramineae each having more than 250 species. The families when arranged as per their number of species would be as follows:—

- 1. Leguminoceae
- 2. Gramineae
- 3. Acanthaceae
- 4. Compositae
- 5. Euphorbiaceae
- 6. Cyperaceae
- 7. Rubiaceae
- 8. Orchidaceae
- 9. Malvaceae

- 10. Convolvulaceae
- 11. Labiatae or Lamiaceae
- 12. Asclepiadeceae
- 13. Scrophulariaceae
- 14. Urticaceae
- 15. Tiliaceae
- 16. Boraginaceae
- 17. Commelinaceae

The flora of Malabar extends into Konkan. Here the plants from the Vindhyan and Indo-ganga plains meet those in Khandesh and in Narmada basin. Comparison, therefore, can usefully be made with the flora of those regions. The greater part of Deccan Tableland is nearly above 2000'(610 mtrs.) from M. S. L. Maharashtra Flora has to be compared with the flora of the whole of Deccan Peninsula. Here the topography changes from hilly regions to plains with black cotton soil spread all over Maharashtra, Madhya Pradesh and South Gujarat. There is

great similarity between the plants of these three regions and those adjoining. As we go south there are progressively higher rainfall and humidity. The humid species go on increasing more and more towards south and west. It is because of this that the Western ghats or Sahyadri regions of Belgaum, Dharwar, Harihar, Kadur districts have rich vegetation of moist deciduous forests and even some ever-green species not to be seen in Maharashtra plains. On the other hand, the northernmost part of the Deccan trap lies in Gujarat. The isolated peak of Pavagarh hill in Gujarat is of Deccan trap origin but rather dry; here the humid species give way to dry deciduous species. There is also a strange resemblance between the flora of Assam and flora of Maharashtra as shown especially by the grasses which are the second most dominant family in Maharashtra. This is accounted for, among other reasons, as due to soils and to migration of species along the Garo hills, Vindhyas, Satpuras right down to Malabar via Sahyadris. They form a route for the migration of species from Malaya to Burma, Burma to Assam, Assam to Garo, Garo to Vindhyas and Satpuras and thence to Konkan down to Malabar. Because of this, there is similarity between the species of Malabar, Assam and Malaya e.g. species of Lilium like L. nilgirenae, grow in Eastern Himalayas and Nilgiris. This problem was very extensively studied with the help of fauna and flora by the late Dr. Sundarlal Vora who formulated his well-known 'Satpura Hypothesis for the migration of species across the continent of India from east to west and thence to south through Satpudas. We shall consider it later again,

The Junagarh hill, Girnar Parvat and Barda-dongar have vegetation of species more or less similar to those in dry parts of Maharashtra and Deccan. It is essentially of dry deciduous type, but is not protected by the high wall of Sahyadris as that in Konkan. The vegetation, therefore, presents a dry and drab appearance for the most part of the year, but produces green verdure of the herbaceous flora in the monsoon and in post-monsoon period as in Maharashtra. The deciduous forests of Girnar produce greenery allround. The flora of Saurashtra resemble with the flora in deciduous forests on the Desh side, and that in drier parts of Konkan like Deogad.

Khandesh is treated as a separate Botanical sub-province. It is rich in alluvial soils and gets moderate rains. Its comparison can be made with flora of South Gujarat and Madhya Pradesh. Nearness of sea is an additional factor which gives it more humidity. But in summer months, it is very dry like that in some districts of Vidarbha.

Hooker (1855) has drawn special attention to the flora of Maval region. We have seen in earlier part that these are the upland narrow valleys generally having altitude between 2000' (610 mtrs.) or more, often drained by a river or hill stream. There is constant moisture in the atmosphere. Soils are shallow and well irrigated and drained being on hill slopes. The flora in the valleys is protected by the hill ranges, but remains isolated from the flora of the rest of Maharashtra and that in other Mayals. As such it develops special character of its own like the vegetation and flora of Sholas in Nilgiris. Only difference is that they do not have very high altitude as that of Sholas in Nilgiris. They contain some montane and rare species and some endemics. Being thickly wooded. they were once upon a time of great strategic importance but indiscriminate hand of man has cut down much of vegetation in them. However, some rare species are preserved only in isolated pockets in them and in the conserved groves of trees dedicated to Gods known as the 'Deorais'.

COMPARISON OF THE MAHARASHTRA FLORA WITH THE FLORA OF ADJOINING REGIONS

The characteristics of flora or vegetation are brought out by: (i) comparison with flora of adjoining territories, and (2) by the study of endemic plants found in them. The principal dominant families of Maharashtra are given on page 284. It will be seen that the Leguminoceae is the largest family, Gramineae, Acanthaceae and Compositae come next. The principal dominant families of the Deccan Peninsula and Malabar are the Gramineae, Leguminoceae, Acanthaceae, Orchidaceae, Euphorbiaceae, Rubiaceae, Compositae, Asclepiadeceae. It will be seen that in the flora of Deccan Peninsula and Malabar the Gramineae is more predominant, Leguminoceae occupying second place; Acanthaceae which consists of mostly shrubs and herbs occupy the third place in both. Compositae with its 98 species occupies the 8th place in Malabar flora, 4th and 5th places are taken by the Orchidaceae and Euphorbiaceae. It is well worth noting that Orchidaceae is rather poorly represented in Maharashtra flora. Families Euphorbiaceae, and Cyperaceae and Rubiaceae occupy nearly the same position except that Cyperaceae are more numerous than Euphorbiaceae in the Malabar flora. Abundance of Cyperaceae suggest more humid and marshy conditions in Malabar, whereas more of Euphorbiaceae suggests drier habitats. Malvaceae is quite abundant in Maharashtra, but is very poorly represented in Malabar. Blatter (1908) has further compared the Bombay flora with the flora of Sri Lanka which is in tropical region. In that region Gramineae is the first dominant family. Leguminoceae the second, and Orchidaceae the third, Compositae, noceae and Melastomaceae come next in succession. Obviously the Malabar flora has more in common with the flora of Sri Lanka than that in Maharashtra which is very much dry compared to Malabar. Therefore its comparison with the flora of the Southern part of Deccan Peninsula, Malabar and Sri Lanka is not appropriate. The Maharashtra flora flourishes under semi-arid conditions and it practically lacks members of Melastomaceae and has preponderance of drier species. The only partial exception to this is the flora of Konkan and of the Ghat regions of Sahyadris. The flora of Southern Gujarat is comparable with the flora of Maharashtra.

In order to appreciate fully these remarks, it is necessary to know and comprehend the flora of the individual constituents of Maharashtra. These are considered here in next pages.

The endemic element will be considered separately later. It is represented by about 42 species in Maharashtra and it gives character to its flora.

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सत्यमेव जयत

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सन्धमेव जयते

SECTION A-FLORA OF MARATHWADA

1. THE REGION

Aurangabad adjoins Jalgaon, Buldhana, Jalna, Ahmednagar and Nasik districts. Jalna, newly created district, adjoins Aurangabad, Buldhana, Parbhani and Bhir. Parbhani is surrounded by Jalna Akola, Yeotmal, Nanded, Latur and Bhir. Nanded is adjoining Latur, Parbhani, Yeotmal districts and Andhra Pradesh. Latur is adjoining Osmanabad, Bhir, Parbhani, Nanded, and Andhra. Osmanabad adjoins Sholapur., Ahmednagar, Bhir, Latur and Andhra.

Naturally the climate and flora of adjoining dry districts of Ahmednagar, Sholapur and Akola have a strong influence on the climate and flora of Marathwada. Kannad ghat joins Marathwada to Khandesh. The plants of these regions are given in the lists that follow. The plants of Ajantha are dry deciduous growing on hill slopes. They contain woody species such as Tectona grandis, Boswellia serrata, Terminalia chebula, Anogeissus latifolia, Dalbergia latifolia, etc. The Kannad ghat in no way compares with the moist deciduous types of Western ghats, which are richer in species than here. The species found are the same as in Nasik and Khandesh districts. The characteristic plants of dry ghats are Capparis horrida, Cochlospermun gossypium, Flacourtia montana and also a few semi-moist species such as Thespecia lampas, Wagatia spicata. The plants of Kinwat consist of a few characteristic species of higher rainfall region especially in rainy season, but the rest are all scrub as in Nasik hills, as the rains last for a few days, followed by a long dry spell.

The lists of species (5—8) show species found in Cooke's Flora of Bombay Presidency, but it also shows a large proportion of plants from the sandy regions of Telangana and neighbouring regions, having had come here. However, it is very likely that as more exploration will be made it may not remain the same and, therefore, we shall not comment more on them here.

2. CLIMATE OF MARATHWADA

- 1. District Aurangabad¹.—The climate of this district is characterized by hot summer and general dryness throughout the year except during south-west monsoons in June to September. The post-monsoon period is October to November. Average annual rainfall in Aurangabad is 725.8 mm. (29"). About 83 per cent of the rainfall is during June to September. July is the rainiest, Rainy days are 45. Cold weather begins by the end of November when the temperature falls rapidly. December is the coldest month. Mean daily maximum temperature is 28.7°C (83.3°F). Hottest months of the year are May-June when the mean daily maximum temperature is 39.8°C (103.6°F) and the mean daily minimum 24.4°C (75.9°F). Daily high temperatures decrease progressively with the withdrawal of monsoons In October, winds are During monsoons they blow West to North. light to moderate. Normal annual rainfall is 725.8 mm. and rarely more. 32.5°C is the annual mean maximum temperature and annual mean minimum is 19.7°C. Relative humidity is 0830 -1730 IST. Wind speed annual mean is 11.8 KPH.
- 2. District Bhir (Beed).—Climate of this district is dry. Cold season is December to February. Rainy days are 41. December is the coldest

Separate details for newly created district of Jalna are not available.

month. Wind blows north-westernly. In May mean daily temperature is about 42°C (107.6°F), but may be as high as 46°C (114.8°F). Daily temperatures begin to increase slightly from the 1st week of October with a secondary maximum in October and humidity is less than 30 percent.

- 3. District Osmanabad 1.—Climate of the district is dry, except in monsoon—June to September. Post-monsoon rains come from October to November. The average annual rainfall is 988.2 mm. (39.5") Rainiest month is July. Average rainy days are 51. Period from middle of February is generally hot. In hottest month mean daily maximum temperature of 40.°C (104°F) and daily minimum about 25.°C. (77.°F). Afternoon thunder showers bring the temperature down, Temperature drops in June with the onset of monsoons. From October, daily temperature begins to increase but the nights become progressively cold even during monsoons. From October to December winds blow north-east to south-east. In May they blow west to north. Rainfall in this district is better distributed than in other districts.
- 4. District Nanded.—The climate of this district is generally dry except in monsoons. The cold season is November to February. Hot season is from March to first week of June. South-west monsoon is from June to the first week of October. Average rainfall is 897.8 mm. (36"). Heavy rainfall is generally in August. Night temperature begins to fall at the end of November. The coldest month is December. Mean daily minimum temperature is 13.°C (55.4°F) and maximum 29.0°C (84.2°F). Cold waves from North India blow west to north. Day and night temperatures continue to rise from March to May. The hottest month of the year is May with 42 °C (107.6°F), but with the advance of monsoon both go down. There is a slight secondary rise in October, after which night and day temperatures decrease. In monsoon 80 per cent of rains come, but in other months of the year there is very little rain, hardly 20 per cent. Winds blow south-west to north-west in monsoons.
- 5. District Parbhani.—Climate is generally hot from March to May. Average rainfall is 888.5 mm. (34.98%). Rainy days are 45. The number varies, at Hingoli they are 41 and at Parbhani 48. Maximum temperature is 29.30 °C (94.7 °F). Minimum is 12.6 °C (54.5 °F). Minimum sometimes falls as low as 5-6 °C (41 °F). Temperature is hottest in May. Weather is pleasant throughout monsoons till the last week of October when temperature begins to drop gradually. Highest maximum at Parbhani recorded is 45.9 °C (114.1 °F) generally in May. Lowest is in January as low as 4.4 °C (39.9 °F). Relative humidity except in monsoon is less than 30 per cent. Winds are north-west in cold season.

It will be seen that the climate of Marathwada on the whole is quite hot and dry. But pleasant is the district of Aurangabad as the night temperatures fall and weather becomes cool and pleasant. It is hot, but not so hot as in Vidarbha districts.

The flora of a place is determined primarily by the climate and then by edaphic factors. The climate here permits growth of dry deciduous species, especially as the rainfall is uncertain and lasts only for a short duration. The gravelly soils are unfertile, only thorny shrubs develop on them. However where the river Godavari flows or the lakes abound, the soils are alluvial, but the weather is severe. The flora therefore tends to be different in different places.

Separate details for newly created district of Latur are not available.

We shall now consider the flora. A consolidated list of plants compiled from the literature available is given in list 5, and the list 6 notes the plants from Ajantha. List 7 gives plants of Kannad Ghat and list 8 of Kinwat. In them there are many plants not given by Cooke (1908) in his Flora of the Bombay Presidency.

It will be seen that about 769 plants belonging to 99 families are so far known. A large number of them are herbaceous and preponderant. Therefore, the monsoon flora looks striking throughout Marathwada sistricts.

3. GENERAL REMARKS ON FLORA OF MARATHWADA

The Six districts of Marathwada lie in the basins of rivers Godavari nd Purna which is its tributary, Flora has developed in their basins. Of these, the flora of Aurangabad district is known in detail. But that of other districts, is not known. Sharfuddin Khan (1953) has written on the Forest Flora of (erstwhile) Hyderabad State, made up then of Kannad area, Telangana and Marathwada. He has included about 198 species from Marathwada region as were known then. But like all other Forest Floras it has its own limitations. These 198 species are spread over 63 families and 141 genera. Tilak (1963) in his 'Flora of Aurangabad District' has described 1335 species belonging to 120 families of Angiosperms, Ahilya Jagatap (1965, 1966) in her articles on Marathwada Flora has described 312 species. Recently Naik (1978) has published a booklet 'Keys to the Angiosperm Families of Marathwada'.

These families, arranged broadly as per number of species known, are:—

1.	Leguminoceae			99
2.	Gramineae			55
3.	Compositae	20131		33
4.	Euphorbiaceae	जयत		33
5.	Labiateae	••	• •	20
6.	Scrophulariaceae		••	16
7.	Apocynaceae		••	15
8.	Cyperaceae			12
9.	Commelinaceae		• •	9
10.	Liliaceae	•		9

The ratio of Dicots to Monocots is 4: 1. From the list of plants in the flora of Aurangabad, it will be seen that this flora and also of Bhir and Osmanabad districts is essentially a flora of dry, semi-arid region. It is a thorn savannah, the same as in the neighbouring districts of Ahmednagar and Sholapur. The reason for this is that Aurangabad is contiguous with the dry districts of Ahmednagar and Bhir, the major part of Osmanabad district and with the extreme dry part of Sholapur district. It is, therefore, a scrub, or thorn savannah. Only the small hilly region of Ajantha and Kannad to the north-west of Aurangabad, the region around Aurangabad, Daulatabad, Kinwat have low hills. From Ajantha 53 species have been recorded and from Kannad ghat 126. From Kinwat however only 31

species are known. They have deciduous forest species and scrub which are similar to those in the dry deciduous forests of Maharashtra. At Kinwat however, and in parts of Osmanabad district there appears to be a mixture of shrubs and herbs from Maharashtra and Andhra Pradesh. This makes the monsoon flora look different.

On the whole, the flora of Marathwada developed on the Deccan trap hills and soils, with about (20-25") 508-635 mm. of rain and (1000-2000') 304-610 metres altitude and flat terrain dotted with low barren hills, is of the same type as that of very dry parts of Maharashtra. It is only the herbaceous flora of places like Osmanabad, Kinwat and Nanded that it is a little different due to contiguity of the sandy region and plants of Telangana, especially in Adilabad district, and of Gulberga district in Karnatak.

The forests on the slopes of Ajantha on Satmala range are similar to the dry deciduous forests of Khandesh and Ahmednagar. The hill flora of Parali Vaijnath is similar to the flora of the low hill of Ramling in Sholapur district. Flora of Aurangabad low hills is similar to the flora of Ahmednagar and surrounding hills.

The characteristic plants of Marathwada region are: Prosopis spicigera, Hardwickia pinnata, Erythroxylon monogynum, Balsamolendron mukul, Litsea polyantha, Phyllanthus reticulatus, Ficus tsisela, F. infectoria, Smilax macrophylla, Balanitts roxburghii, Leea aspera, Capparis divaricata, Kadaba indica, Zizyphus nummularia, Ventilago calyculata. Many of these plants are not found in soils derived from grantic and calcarious soils of Telangana. All these are the plants which belong to scrub jungles. They indicate a very dry and hot region. In this connection, the temperatures at a number of places in Marathwada districts are worth noting for comparison with Sholapur, and Ahmednagar. They are as hot as some of the places like Jalgaon in Khandesh or Akola in Vidarbha. But the rainfall is well distributed and winter temperature low due to which the climate becomes good for Rabi season crops, especially jowar.

4. Flora of Hilly Regions of Kinwat, Ajantha, Kannad and Aurangabad

Observations on the plants of hilly regions of Kinwat, Ajantha and Kannad ghat are listed in Lists 6-8. It is obvious that there are more herbaceous representatives. The species of trees are few e. g., Adina cordifolia, Hamiltonia suaveolens, Dalbergia paniculata, Bauhinia lanzan, Terminalia paniculata. Monocots also are few. A species of Orchids, Vanda tesellata is known only from Kinwat. It is obvious that this place in the rainy season is humid, otherwise dry.

A list of plants of Ajantha shows that the majority of species here are the same as on the low hills of Nasik, Khandesh and Ahmednagar. The following species are common to Western Maharashtra hills and Ajantha hill slopes, Terminalia chebula, T. arjuna, Anogeissus latifolia, Dalbergia latifolia. There are large stands of Rosa-oil grass Symbopogon martini. It contains a few plants slightly different but their number hardly exceeds 12. For example Nyctanthes arbortristis, Wrightia tictoria, are very distinct here than in the deciduous forests of Western ghats.

The Kannad ghat, on the other hand is richer in species. They are similar to those that are found in the ghats of Nasik and Khandesh districts. Characteric plants of such dry ghats are Capparis horrida,

Flacourtia montana, Cochlospermum gossypium. At the same time plants like Kydia calycina, Thespesia lampas, Impatiens parviflora, Wagatia, spicata, Bauhinia vahlii, Melastoma Xeromphis spinosa, Olea dioeca, Mallotus rariflora, Habinaria marginata (which are two tropical ground orchids) are characteristic of high rainfall moist region of Western ghats. They are also found here in Kannad ghats. However the soils in the Kannad ghat being poor, there is mixture of dry hilly species and some humid species. In this they differ from typical ghat forests in Sahyadries.

5. LIST OF PLANTS FROM MARATHWADA

Name		Flowering season	Locality
Family Ranunculaceae: Clematis gouriana Roxb. C. triloba.		Cold weather	Mahadeo hills
Family Dilleniaceae Dillenia pentagyna Roxb. D. indica Linn.	4	June-July	Mahadeopur, Godavari forest
Family Magnoliaceae Michelia champaca Linn.		April –June	Cultivated
Family Annonaceae: Artabotrys odoratissinus = Artabotrys hexapetalus Polyalthia cerasoides Ben and Hook. P. longifolia Benth and Ho f. Annona squamosa Linn. Annona reticulata Linn. A. muricata Linn. Millusa velutina Hook. f. a Th. Cananga adorata	th ook.	Sent College	
Family Menispermaceae: Cissampelos pariera Linn. Cocculus villosus DC. = C. hirsutus (L.) Diels. Cyclea burmanii = C. peltata (Lamk.) Diels. Tinospora cordifolia (Will Miers.	•• ••	September-Oct. February—March January	(cultivated). Osmanabad, Aurangabad. Marathwada
Family Nymphaeaceae: Nymphaea lotus Linn. N. stellata Willd. N. nouchali Burm. f. Nelumbo nucifera Gaertn.		September—Feb.	Common in the State. Common through- out State. Aurangabad

Name	Flowering season	Locality
Family Papaveraceae: Argemone mexicana Linn. Papaver somniferum Linn	July-September	Osmanabad
Family Fumarieaceae: Fumaria parviflora	December—Feb	. Osmanabad
Family Cruciferae : Nesturtium officinale Eruca sativa		
Brassica juncea (Linn.) Cezern B. nigra (Linn.) Koch Iberis amara Linn. Lepidium sativum Linn.	August—Dec November—Feb September—Jan November—Jan	Aurangabad Osmanabad
Raphanus sativus Linn Family Capparidaceae:	October—Jan	Osmanabad
Cadaba indica Lamk. Capparis brevispina HK. f C. decidua (Forsk.) Pax	December—Feb August—October July-August April—July	Aurangabad Osmanabad Osmanabad
C. divericata Lam. C. grandis Linn. C. zeylanica Linn. C. sepiaria Linn.	March—July March—July March—July	Osmanabad Osmanabad Osmanabad
C. horrida Linn. Cleome gynandra Linn. C. chelidonii Linn. f. C. simplicifolia Hk. f. and Thw. Crataeva religiosa Forst. = C. narvalea Buch-Ham.	June-October	Osmanabad Osmanabad Aurangabad Mahadeopur
ramily violaceae:	मिव जयत	
Hybanthus suffruticosus (Linn) Bail. et Lan. —Hybanthus enneaspermus (Linn.) Muell.	August—October	Osmanabad
Family Bixaceae:		
Cochlospermum religiosum (Linn.) Alston.	February—May	Aurangabad
C. gossypium DC Bixa orellana Linn	December-April	
Flacourtia indica (Burm.) f. Merr.	February—May	Aurangabad
F. montana Grah F. ramontchi L. Herit F. sepiaria Roxb	November-Dec. March-April	Hyderabad forest Aurangabad
Family Polygalaccae: Polygala bulbothrix Dunn P. chinensis Linn P. erioptera DC P. persicariaefolia DC	August—Nov June—January July—October August—October	Ajantha Osmanabad Osmanabad Aurangabad

Name	Flowering season	Locality
Family Caryophyllaceae: Dianthus chinensis Linn	October—Jan	Aurangabad
D. plumaris Linn Polycarpea corymbosa Lamk. Vaccaria pyramidata Medik.	September—Feb. August—Nov. October—Feb.	Aurangabad Osmanabad Aurangabad
Family Portulaceae:	0.4.1	0
Portulaca pilosa Linn var. hortualis Linn. P. quadrifida Linn	October-Nov September—Dec.	Osmanabad Osmanabad
Family Elatinaceae:		
Bergia ammanioides Roxb B. aestivosa W and A	October—Jan October—Jan	Osmanabad Aurangabad
Family Pittosporeae:		
Pittosporum floribundum W. and A.	In cold season	Aurangabad
Family Tamaricaceae:		
Tamarix ericoides Rottl Tamarix dioica Roxb T. gallica Linn	September—Dec. May-June	
T. articulata Vahl.	May-Sept	
Family Guttiferae (Clusiaceae):	Way.	
Calophyllum inophyllum Linn. Mesua ferea Linn	December-Jan. March	
Family Malvacae:		
Thespesia lampas (Cav.) Dalz and Gibs.	Rainy season	** 1 1 1
T. populanea (Linn.) Soland ex Corr.	••	Hyderabad Aurangabad
Kydia calina Roxb	At the end of hot season and in cold season.	
Bombax malabaricum	Cold season	A d
Eriodendron anfractuosum DC Adansonia digitata Linn	January—March	Aurangabad
Abelmoschus crinitus Vall A. ficulneus (Linn.) W and A	August-September OctoberDec	Nanded Osmanabad
A. manihot (Linn.) Medik	OctoberDec	Osmanabad
Abutilon glaucum Cav A. hirtum G. Don	October—Dec October—Dec	Osmanabad Osmanabad
A. hirtum G. Don A. indicum Sweet	June-December	Osmanabad
Althea rosea Eav Ceiba pentandra Gaertn	All the year December-Jan	Aurangabad
Gossypium herbaceum Linn.	July—September	Aurangabad Aurangabad
Hibiscus cannabinus Linn H. lobatus	August—October. September-Nov	Aurangabad Aurangabad
H. micranthus Linn	September-Jan	Osmanabad
H. panduraeformis Burm H. rosa-sinensis Linn	September—Jan	
H. schizopetalus Hook. f	September—Jan	Osmanabad

Name	Flowering season		Locality
Mulva sylvestris Linn. var.	December-Jan.	• •	Aurangabad
mauritiana Boiss,	June-Jan.		Aurangabad
(Linn.) Gareke. Sida acuta Burm. f	August-Oct.		Osmanabad
S. glutinosa Cav	Sept-Jan.	• •	Osmanabad
S. spinosa Forsk	Aug-Jan.	••	Aurangabad Osmanabad
S. veronicifolia Lam. —S. cordata (Burm. f.) Borssum.	July-Sept.	••	Osmanavad
l-amily Sterculiaeae:			
Dombeya acutangula Cov	Jan-Feb.	• •	Aurangabad
Eriolaena hookeriana W and A.	Aug-Sept.	• •	Beed, Aurangabad.
Guazuma tomentosa H. B. K.	Mar-Apr.	• •	Aurangabad
Helicteres isora Linn	Aug-Sept.	• •	Aurangabad
Kleinhovia hospita Linn	Dec-Jan.	• •	Aurangabad
Melochia corchorifolia Linn.	Sept-Oct.	• •	Western ghats
Pterospermum acerifolium Willd.	138kg	• •	Aurangabad
Sterculia urens Roxb		• •	Nanded
Waltheria indica Linn		• •	Aurangabad
Sterculia villosa Roxb		• •	Aand
S. colorata Roxb	Mar-Apr.	• •	Aurangabad
—Firmana colorata (Roxb.) A. Br.	AVILLE		
Family Tiliaceae:	1 1 1 1		
Grewia tiliaefolia Vahl			• •
G. populifolia Vahl	Sept-Oct.		• •
G. asiatica Linn	Mar-Apr.	• •	
G. pilosa Lamk	Sept-Oct.	• •	Aurangabad
G. salvifolia Heyne		• •	O
G. abutilifolia Vent.		• •	Osmanabad
G. hirsuta Vahl.		• •	Osmanabad
Corchorus aestuans Linn		• •	Aurangabad Osmanabad
C. fasicularis Lamk	A a Ni av	• •	Osmanabad
C. olitorius Linn. Corchorus trilocularis Linn.	Aug-Nov.	••	Osmanabad
Triumfetta rhomboidea Jacq.	Oct-Dec.	• •	Aurangabad
T. rotundifolia Lamk.	Aug-Dec.	••	Osmanabad
Family Linaceae:			
Linum mysorense Heyne			Aurangabad
L. usitatissimum Linn	Sept-Oct.		Osmanabad
Hugonia mystex Linn.			Mahadeopur
Erythroxylon monogymum Roxb.	••	•	
Family Malpighiaceae:			
Hiptage madablota GaertnH. bengalensis (Lam.) Kur	Cold season z.	••	••
Aspidopteris cordata A. Juss.	Mar-April		Aurangabad
Thryallis glauca Kurtzl 👢	Camb Mak	• •	Aurangabad

Name	I	Flowering season	n	Locality
Family Geraniaceae:				
Biophythm helenae Busc. et Mush.		Sept-Feb.	••	Osmanabad
B. sensitivum DC. Impatiens balsmina Linn. Oxalis corniculata Linn. Tropaeolum majus Linn. Averrhoa carambola Linn. A. bilimbi Linn.		Sept-Feb. Sept-Oct. June-Jan. Sept-Nov.	••	Osmanabad Aurangabad Osmanabad Hyderabad
Family Rutaceae:				
Murraya koenigii Linn. Limonia acidissima Linn. L. eleutherandra Dalz. Atlantia monophylla Correa Citrus medica Linn.	••	Mar-Apr. Apr-May Hot season Oct-Dec.		 Warangal forest
C. aurantium Linn.	• •		• • •	• •
C. decumana Linn.		TT 4 41	• •	• •
Feronia elephantum Correa Aegle marmelos Correa	_	Hot weather Mar-May	• •	• •
Ruta graveo lens Linn.		Sept-Mar.	••	Osmanabad
Family Simaroubaceae:				
Ailanthes excelsa Roxb. Balanites roxburghii (Linn.) Delile.	03	Feb-Mar. Nov-Mar.	••	Osmanabad Osmanabad
Family Ochnaceae:	H			
Ochna squarrosa DC		Mar-Apr.	••	Mahadeopur
Family Burseraceae:	स	यमेव जयते		
Boswellia serrata Roxb. Garuga pinnata Roxb. Balsamodendron mukul Hook f.	••	Apr-May Hot weather	••	Marathwada Berar and Khandesh.
B. caudatum		March	• •	• •
Family Meliaceae:				
Azadirachta indica A. Juss.		Feb-Apr. July-Sept.	• •	Osmanabad Osmanabad
Melia azadirchta Linn. Soymida febrifuga A. Juss.	••	Feb-May	••	Parbhani,
		•		Nanded.
Heynea triguga Roxb. =Trichilla connaroides (W. and A.) Benth.	••	••		Aurangabad
Cedrela toona Roxb.		• •		Ajantha
=Toona ciliata Roem. Chloroxylon swietania DC		••		Not very common
Family Olacinaceae:				
Ximenia americana Willd. Olax wightiana Willd.		••		Fairly common Fairly common
O. scandens Roxb.		• •		in Aurangabad

Name	Flowering season	Locality
Family Rhamnaceae:		
Ventilago denticulata Willd. Zizyphus mauritiana Lamk. Z. oenoplia (Linn.) Mill Z. trinervia Roxb Z. xylopyra Willd	Nov-Jan Sept-Nov Sept-Nov Aug-Nov	Osmanabad Aurangabad Aurangabad Aurangabad Common in forest
Family Vitaceae:	Aug Cant	Osmanabad
Ampelocissus latifolia (Roxb.) Planch.		
A. tomentosa Planch	June-July	Parbhani Nanded
Cayratia carnosa Gagnep	Aug-Oct June-Aug	Osmanabad
Cissus pallida Planch = Vitis pallida.	_	
C. setosa Roxb.	Sept-Dec	Aurangabad Osmanabad
C. vitiginea Linn.	Sept-Nov	Common in
Vitis quadrangularis Wall. —Cissus quadrangularis.	• •	hedges
V. latifolia Roxb.		Common climber
V. pallida W. and A		in forest Conspicuous shrub in dry rocky hills.
V. vinifera Linn		Cultivated in Aurangabad.
Leea aspera Wall =-Leea edgeworthii Sant.	MAN	Under shrub
Family Sapindaceae:		
Cardiospermum halicacabum Linn.	Sept-Oct	Osmanabad
Dodonea viscosa Jacq	Oct-Dec	Aurangabad
Sapindus emariginatus Vahl.	Oct-Nov	Osmanabad
S. laurifolius Vahl	Oct-Nov	Osmanabad
Family Anacardiaceae:		
Mangifera indica Linn	Feb-March	Osmanabad
Lannaea coromandelica (Houtt.) Merr.	Jan-Mar,	Osmanabad
Rhus mysorensis Heyne ex W. and A.	Jan-Aug	Osmanabad
Semecarpus anacardium Linn.	Oct-Nov	Osmanabad
Spondias mangifera Willd.	Feb-Mar	Aurangabad
Buchanania latifolia Roxb.	• •	Common in forest
Odina wodier Roxb.		Common and always in association with Boswelia serrata
Family Papilionaceae:		
Abrus precatorius Linn Aeschynomene aspera Linn. A. indica Linn.	. Aug-Sept Oct-Feb . Oct-Feb	Osmanabad Bhandara Osmanabad
AT SHOWING PARTIES.		

Name	Flowering season	Locality
Alysicarpus bupleurifolius DC.	Sept-Oct	Osmanabad
A. longifolus W. and A	Comt Oat	Osmanabad
A. pubescens Law	Care Oak	Osmanabad
A. rugosus var, styracifolius	Camb Oak	
Baker.	Sept-Oct	Osmana b ad
A. rugosus var. heyneanus- Baker.	Aug-Jan	Osmanabad
—A. scariosus.		
A. tetragonolobus	Aug-Jan	Osmanabad
A. vaginalis DC	Aug-Jan	Osmanabad
Arachis hypogea Linn	Sept-Oct	Aurangabad
Atylosia scarabaeoides Benth.	. Aug-Oct,	Osmanabad
Butea monosperma (Lamk.) Taub.	Mar-Apr	Osmanabad
Cajanus cajan (Linn.) Millep.	Oct-Jan	Osmanabad
Cicer ariatinum Linn	Dec-Feb	Osmanabad
Clitoria ternatea Linn	Oct-Feb	Osmanabad
Crotalaria albida Hyena ex	Ost Iss	Osmanabad
Roth.	Oct-Jan	Osmanavau
C. filipes Benth	Aug-Oct.	Osmanabad
C. juncea Linn.	Aug-Oct.	Osmanabad
C. hirsuta Willd.	Aug-Oct.	Nanded
C. linifolia Linn. f.	Cout Ton	Osmanabad
C. medicaginea Lamk	Comt Ton	Osmanabad
C musarancia Path	Oat Dag	Osmanabad
C. decasperma Naik	Oat Dag	Osmanabad
C. pusila Heyne ex Roth	Aug Oat	Osmanabad
C. retusa Linn.	Cont Inn	Osmanabad
C suifaliansmus	Cant Tan	
C nouse Time	Arra Oat	Aurangabad Osmanabad
C. verrucosa Linn, C. willdenoviana DC.	Aug Oat	
Cyamopsis tetragonoloba	Luly Comt	Aurangabad
(Linn.) Toub.	Juty-sept	Aurangabad
Cylista scariosa Roxb	Sept-Nov	Aurangabad
Dalbergia latifolia Roxb	Aug-Oct	Osmanabad
Desmodium dichotomum DC.	Sept-Nov	Osmanabad
D. gangeticum DC	Sept-Nov.	Osmanabad
D. triflorum DC	Sept-Nov	Osmanabad
D. velutium (Willd.) DC	Sept-Nov	Osmanabad
Dolichos biflorus Linn	Sept-Nov	Osmanabad
Eliotis sororia DC.	Sept-Oct	Aurangabad
Flemingia bracteata Wt	Sept-Oct	Aurangabad
Glycine max Merr.	Nov-Jan	Parbhani
C. wightii (W. and A.) Verd.	Nov-Jan	Osmanabad
Heylandia latebrosa DC	Jan-Dec	Osmanabad
—Goniogyne hirta.	Cont Dos	Oama1 4
Indigofera barleri Gamble	Sept-Dec	Osmanabad
I. cordifolia Heyne ex Roth	June-Jan	Osmanabad
I. glandulosa Willd	July-Nov	Osmanabad
I. glandulosa var. sykesii Roxb.	June-Nov	Osmanabad
I. hirsuta Linn	Aug-Oct	Osmanabad
I. hoyer Forsk	Oct-Dec.	Osmanabad
I. linifolia Retz	July-Dec	Osmanabad
I. linifolia var, lampbellii	July-Dec	Osmanabad
-	-	

Name	Flowering season		Locality
I. linnaei Ali.	. June-Oct.		Osmanabad
I. parviflora Heyne	. June-Oct.		Osmanabad
I. pullchella Roxb —I. cassioides.	Jan-Oct.	••	Aurangabad
I. spicata Forsk .	. Aug-Dec.		Osmanabad
I. tinctoria Linn.	A Th		Osmanabad
I. trita Linn.	Y ~ 3.7		Osmanabad
I. wightii Grah.	A . T		Aurangabad
Lablab niger Medik	0-4 D		Osmanabad
Lathyrus sativus Linn.	D D 1		Osmanabad
Medicago sativa Linn	A 11 41		Osmanabad
Melillotus alba Lam	Y 1 /		Aurangabad
M, indica All	D . 3.4		Osmanabad
Mucuna prurita Hook	A Nime		Osmanabad
Phaseolus sublobatus Roxb.	Aug-Oct.		Osmanabad
Rhynchosia minima DC	or 7 r		Osmanabad
Rhynchosia minima var laxiflora Baker.	O T . T .	••	Osmanabad
R. sericea Span	July-Sept.		Aurangabad
Sesbania bispinosa (Linn.) Grew.	A 0	••	Osmanabad
S. sesban var. picta (Pr.) Sant.	Nov-Jan.	••	Osmanabad
S. grandiflora Dres	Nov-Jan.		Osmanabad
Shutaria sp			Aurangabad
Tephrosia hamiltonii Drumm.	Aug-Feb.		Osmanabad
T. hirt Ham	The state of the s		Osmanabad
T. pentaphylla Sweet	Oct-Dec.		Aurangabad
T. purpurca pars	CONTRACTOR AND ADDRESS OF THE PARTY OF THE P		Osmanabad
T. procumbena Ham	The state of the s		Osmanabad
T. strigosa (Dalz.) Sant. et Mahesh.		•• '	Osmanabad
Tetramnus labialis (Linn.) Spreng.	Aug-Oct.	• •	Osmanabad
Vicia faba Linn	Dec-Jan.		Aurangabad
Zornia diphylla (Retz.) Pers	July-Dec.	••	Osmanabad
Family Caesalpiniaceae:	0.47		O males d
Bauhinia purpurea Linn	Oct-Jan.	• •	Osmanabad
B. racemosa Lamk	April-June	• •	Osmanabad
B, tomentosa Linn, forma concolor DÇ. Wit.	Aug-Sept.	••	Osmanabad
B. variegata Linu.	Oct-Jan.	• •	Aurangabad
Caesalpinia bonducella Flem.	Sept-Nov.	• •	Osmanabad
C. decapetala (Roth) Alston	Sept-Jan.	• •	Osmanabad
C. pulcherrima Gw	Aug-Nov.	• •	Osmanabad
Cassia absus Linu	Aug-Nov.	• •	Osmanabad
Cassia auriculata Roxb	Aug-Nov.	• •	Osmanabad
C. obtusifolia Linn	July-Oct.	• •	Osmanabad Osmanabad
C. pumila Lamk	. • _	• •	Osmanabad Osmanabad
C. siamea Lamk	Sept-Dec.	• •	Osmanabad
C. surattense Burm	Sept-Dec, July-Jan.	• •	Osmanabad
C. tora Linn Colvillea racemosa Boj	O-4 D-4		Aurangabad
Delonix elata (Linn.) Gamble			Osmanabad
Parkinsonia aculeata Linn		• •	Osmanabad

Name	Flowering season	Locality
Family Mimosaceae:		
Acacia campbellii L. A. chundra (Roxb) Willd. A. farnesiana (Linn.) Willd. A. leucophloca Willd. A. nilotica (Linn.) Del. A. pinnata (Willd.) A. tora Craib. Albizzia lebbek Benth A. julibrissin Derr. Dichrostachys cinerea W. and A.	Dec-Jan. Sept-Jan. Sept-Jan. Aug-Jan. Aug-Jan. Oct-Jan. July-Dec. March-May March-May July-Oct.	Osmanabad Osmanabad Osmanabad Osmanabad Nanded Aurangabad Osmanabad Nanded
Leucaena glauca Benth	Oct-Dec	Osmanabad
= L. leucocarpala. Neptunia triquetra Benth Mimosa hamata Willd. Prosopis juliflora DC. P. specigera Linn. Parkia biglandulosa Benth, Samanea saman (Jacq.) Merr.	Aug-Oct. July-Dec. Oct-Dec. Dec-Feb. Feb-June	Osmanabad Osmanabad Thorny tree Thorny tree
Family Rosaceae:		
Potentilla supinum Linn Rosa canina Linn R. damascena Linn	March-April July-Oct July-Oct	Aurangabad Aurangabad Aurangabad
Family Saxifragaceae:	7537	
Vahlia dichotoma O. Ktze	Dec-Jan	Osmanabad
Family Crassulaceae:	विकास कार्य प्रेंग जगने	
Kalanchoe bhidei T. Cooke K. diegremontiana Hand K. pinnara (Lamk.) Pers	Dec-Jan Dec-Jan	Aurangabad Aurangabad Aurangabad
Family Combretaceae:		
Anogeissus latifolia Wall Combretum ovalifolium Roxb. Terminalia arjuna W. and A. T. catappa Linn	Sept-Nov. March-April March-April Feb-March June-Jan. March	Osmanabad Osmanabad Osmanabad Aurangabad Osmanabad Common along forest paths.
Family Myrtaceae:		
Callistemon lanceolatus Sweet Eucalyptus cladocalyx F Muell.	Oct-Dec Sept-Oct	Aurangabad Parbhani
Psidium guyava Linn	Oct-Nov March-May	Aurangabad Osmanabad
Eugenia heyneana Wall		Common along water courses.

PLOKA C	OF MAKAIHWADA		•
Name	Flowering seaso	n	Locality
Family Lythraceae:			
Ammannia baccifera Roxb. A. baccifera var. aegyptiaca	Aug-Oct. Aug-Jan.	••	Aurangabad Aurangabad
Koehna.	_		sr 1 1
A. multiflora Roxb. Lagerstrocmia parviflora	Sept-Nov. Feb-April	• •	Nanded Aurangabad
Roxb. Rotala densiflora Koehne	Oct-Jan.		Nanded Mhaismal
R. indica Koehne	Oct-Jan.	• •	Osmanabad
R. seroyllifolia (Roth) Bram. Woodfordia fruticosa Kurz	Dec-Feb. Feb-April	••	Aurangabad
Family Onagraceae:			Dumbhani
Clarkia concinna Greene	Dec-Jan.	• •	Parbhani Parbhani
Epilobium hirsutum Linn	July-Aug.	• •	Paronam
Family Samydaceae:	March-April		Aurangabad
Caseria tomentosa Roxb	Match-April	• •	Aurungasaa
Family Passiflaraceae:	FER		
Passiflora edulis Sims	Sept-Oct.		Osmanabad
Family Cucurbitaceae:			Aurangabad
Blastania fimbristipulata (Fenz.) Kotz. and Pur	Oct-Jan.	••	
Colocynthis vulgaris Schrad	Feb-March		Osmanabad
Coccinia cordifolia (Linn.)	. July-Dec.	•	Osmanabad
Cogn. Corallocarpus epigaeus Clarki H. K. f.	CONTRACTOR OF THE PARTY OF THE	••	Osmanabad
Cucumis callosus (Rottl.) Cogen.	. Aug-Oct.	••	Osmanabad
C. melo var. agrestis Haud.	Aug-Oct.		Osmanabad
Cucurbita moschata (Duch.)	Dec-Jan.	• •	Osmanabad
Poir. Diplocyclos palmatus (Linn.)	Aug-Jan.		Osmanabad
Jeffery. Melothria maderaspatana .	. Aug-Jan.	• •	Osmanabad
Cagn. = Mukia <i>maderaspatana</i> .			0
IN DITTOR CALCULATION AND INC.	. Aug-Oct.	• •	Osmanabad
Trichosanthes anguina Linn.	Sept-Oct.	• •	Osmanabad Osmanabad
T. cucumerina Linn.	. Sept-Oct.	••	Oshranabau
Family Cactaceae:			0 11
Opuntia elatior Mill .	. Sept-Oct.	• •	Osmanabad
Family Aizoaceae:			
Glinus lotoides Linn.	. Oct-Jan.		TO THE STATE OF
G. oppositifolius Linn.	. Oct-Jan.		
Mollugo cerviana Ser.	Oct-Jan.	• •	Aurangabad Osmanabad
	Sept-Oct.	• •	Osmanabad
Trianthema decandra Linn.	June-Aug.	• •	. Osmanabad

Name	Flowering season	Locality
Trianthema pentandra Linn. T. portulacastrum Linn. T. triquetra Linn	June—October	Do.
Family Apiaceae (Umbelliferae)	:	
	December-Jan December-Feb. November-Jan.	Osmanabad
Family Rubiaceae:		
Anotis montholonii Hook. f. = Neanotis montholoni	July—October	Osmanabad
Borreria hispida (Linn.) Schum.		Do.
B. stricta (Linn.) Schum Canthium parviflorum Benth.	May-June	Do. Do.
Dentella repens Forsk	July—October	
Gardenia lucida Roxb. Ixora arborea Roxb. ex. Sm.	May—July Luly—Sentember	Osmanabad Osmanabad
L. parviflora Vahl	July Septemoer	Common tree in forest.
Kohoutia aspera (Heyne ex Roth) Bremek.		Osmanabad
Morinda tomentosa Heyne	March—July	
M. tinctoria Roxb Xeromphis spinosa (Thumb.)	March—July	Aurangabad
Keay.	March-June	Osmanabad
Family Asteraceae (Compositae)	(A) (A) (A)	
Acanthospermum hispidum DC.	8000 C C 200 C 2 C C C C C C C C C C C C	Osmanabad
Ageratum conyzoides Linn	July-December	Do.
Bidens biternata (Lour.)	July-October	Do.
Merr. er Sch.	Danishan T. 1	
	December—Feb. December—Feb.	Osmanabad Do.
B. l'acera var. glandulosa		Do.
Hook. f.		20,
B. mollis (Don.) Merr.		Do.
Blumea obliqua (Linn.) Druce. B. oxydonta DC		Osmanabad Do.
B. oxydonta DC	August-September	Do. Do.
Caesulia axillaris Roxb	JulyDecember	Do.
Callistephu chinensis Nees	October—Jan.	Aurangabad
Cosmos sulphureus Cav	September—Jan.	Osmanabad
Cyathocline purpurea (Don.) O. Ktze.	December—Feb.	Do.
Dichoma tomentosa Cass	October—Dec June—October	Do.
Erigeron asteroides Roxb E. speciosus DC	October—Dec	Do.
Flaveria repanda Lagasca	September—Jan.	Do. Do.
Gaillardia aristata Pers	September-Oct	Aurangabad
Glossocardia bosvellae DC	July—Oct.	Osmanabad
Goniocaulon glabrum Cav	September-Dec.	Aurangabad
Gnaphalium Indicum Linn	December-Jan	Mahur

Name	Flowering season	Locality
Grangea maderaspatana Poir. Lagascea mollis Cav. Launaea nudicaulis Hook. f. = L. procumbens	October—Feb July—October September—Feb.	Aurangabad Aurangabad Aurangabad
Parthenium hysterphorus Linn. Pulicaria wightiana Clarke Senecio hewrensis Hook. f Sonchus asper Hill S. oleraceus Linn. Sphaeranthus indicus Linn. Spilanthes paniculata Wall. Tricholepis glaberrima DC Tricholepis radicans DC Tridax procumbens Linn. Vernonia anthelmintica Willd. V. cinerea (Linn.) Less. Vicoa indica (Linn.) DC Zinnia elegans Jacq Z. peruviana (Linn.) Linn	June—February August—Oct September—Jun. July—December July—December September—Feb. October—Feb July—September June—December September-Oct June—March December-Jan September-Oct	Osmanabad Osmanabad Aurangabad Osmanabad Osmanabad Osmanabad Osmanabad Osmanabad Osmanabad Osmanabad Osmanabad Aurangabad Aurangabad Aurangabad Osmanabad Osmanabad
Family Campanulaceae: Companula alphonsii Wall	December—Feb.	Aurangabad
Family Plumbaginaceae: Plumbago zeylanica Linn. Limonium vulgare Mill.	September-Oct June-July	Aurangabad
Family Primulaceae	EX BIALL	
Anagallis arvensis Linn var. coerulea Godr	September—Feb.	Aurangabad
A. pumila Sw	September—Feb.	Parbhani
Family Sapotaceae:	प्रमेव जयत	
Achras sapota Linn = Manilkara sapota	January—June	Osmanabad
Bassia latifolia Roxb Madhuka indica Gmel Mimusops elingi Linn M. hexandra Roxb =Manilkara hexandra	February—April February—Jan	Wild or cultivated Aurangabad Osmanabad Evergreen tree
Family Ebenaceae:		
Maba nigrescens Patr = 1\(\)iospyros nigerescens Diospyros chloroxyoln Roxb. D. montana Roxb	October-Nov.	Aurangabad Osmanabad Evergreen tree on
D. candolleana Wight .		dry hills. Aurangabad
Family Oleaceae:		
Jasminum arborescens Roxb. J. grandiflorum Linn. J. calophyllum Wall J. officinale Linn	March-April . Aug.—October . September-Oct August—Oct.	Osmanabad Aurangabad Osmanabad Osmanabad

Name	Flowering season	Locality
Jasminum mesnyi Hance J. roxburghianum Wall. ex Hk. f.	September-Oct June—Sept	Parbhani Osmanabad
Nyctanthes arbortristis Linn. Schrebera swietenioides Roxb.	August—Dec February—April	Osmanabad Aurangabad
Family Salvadoraceae:		
Salvadora persica Linn	January-March	Aurangabad
Family Apocynaceae:		
Carissa congesta Wt Holarrhena antidysenterica Wall.	March—May March—May	Osmanabad Aurangabad
Lochnera pusilla (Linn.) Schum.	July-September	Osmanabad
Vallaris heynei Spr	March-April	
Wrightia tinctoria R. Br W. tomentosa Roem	April—June	Aurangabad Aurangabad
Family Asclepiadaceae:	(Fired)	
Ceropegia hirsuta W. and A. C. tuberosa Roxb	September-Oct September-Oct	Aurangabad Aurangabad
Cryptolepis buchanannii R.	August—October	Osmanabad
Dregea volubilis Benth	January-March	Aurangabad
Gymnema sylvestre R. Br Calatropis gigantea Brald	October-Jan	Osmanabad Common along villages and waste lands.
C. procera Br. Hemidesmus indicus Hk. f. R. Br. var. rubescens	September-Oct	Osmanabad
Holostema annulare (Roxb.) Schum.	August—Oct	Osmanabad
Sarcostemma brevistingna R. Br.	February—April	Aurangabad
S. secamone (Linn.) Bennett. Stapelia gigantea N. E. Br	July—September September-Oct	Parbhani Aurangabad.
Telosma pallida (W. and A.) Craib.	September-Oct	Osmanabad
Tylophora indica (Burm. f.) Merr.	September-Oct	Osmanabad
Tylophora rotundifolia Ham. Pergularia pallida Awand A.	June—September	Aurangabad Common in hedges in scrub jungles.
Family Loganiaceae: Strychnos potatorum Linn, F.	Santamher_Oct	Osmanabad
S. nux-vomica Linn	Septemoer-Oct	Common in forest.
Family Gentianaceae: Canscora decurrens Dalz	December—Feb.	Osmanakad
C. pauciflora Dalz	November—Feb.	Osmanabad Osmanabad
Centaurium roxburghii (Don.) Druce. A-127—20-B.	October—Jan	Osmanabad

Name	Flowering season	Locality
Enicostema littorale Bl Exacum pedunculatum Linn. Hoppea fastigiata Clarke Nymphoides cristatum (Roxb.) O. Kuntze.	June—January September—Nov. September—Nov. December—Feb.	Aurangabad Osmanabad Osmanabad Nanded
Family Polemoniaceae: Phlox drummondii Hook	October—Jan	Aurangabad
Family Boraginaceae:		
Carmona retusa (Vahl.) Masam.	August-September	Aurangabad
Cordia dichotoma Forst. f		Aurangab a d
Cordia gharaf (Forsk.) Ehrenb. and Sch.	April—June	Osmanabad
C. macleodii Hk. f. and T and T.	March—May	Aurangabad
C. sebestina Linn	February—May	Aurangabad
Cynoglossum meeboldii Brand.	August—October	Aurangabad
Ehretia laevis Roxb.	March—May	Aurangabad
Heliotropium ovalifolium	October—Feb	Osmanabad
Forsk. H. rariflorum Stocks H. scarum Retz. var. wallichii Clarke	August—October September —Jan.	Aurangabad Osmanabad
H. supinum Linn Trichodesma amplexicaula	October—Jan September-Oct	Osmanabad Osmanabad
Roth. Trichodesma indicum R. Br Rhabdia lycicoides Mart = Rotula aquatica	July—Jan	~
Family Convolvulaceae:		
Convolvulus arvensis Linn	October—Jan	Osmanabad
C. rottlerianus Choisy	January-Feb	
Evolvulus alsinoides Linn Hewittia sublobata (Linn. f.)	JulyFebruary October-Nov	
O. Kuntze.	October—Feb	Osmanabad
Ipomoea carrica Sweet I. fistulosa Mart. ex. Choisy	October—Feb	Nanded
I. eriocarp a R. Br	October-Feb	
I. hederif olia Linn	October-Dec	Osmanabad
I. horsfalliae Hook		
I. leari Paxt	October—Feb	
I. muricata Jacq	October—Feb October—Feb	A
I. nil (Linn.) Roth	Ostobor Esh	0 1 1
I. obscura Ker-Gawl I. pestigridis Linn	October Ech	
I. purpurea Lam	October-Feb	, ,
I. quamoclit Linn	September—Feb.	Osmanabad
Merremia aegyptia (Linn.)	October—Feb	. Osmanabad
Urban. M. emarginata Hall. f	October-Feb	Osmanabad

Name	Flowering season	Locality
M. quinquefolia (Linn.) Hall.	October-Feb	Osmanabad
Porana paniculata Roxb Rivea hypocrateriformis Choisy. Rivea ornata Choisy	October—Feb September—Jan.	Aurangabad Osmanabad
Family Solanaceae:		
Datura metel Linn Nicandra physaloides (Linn.) Gaertn.	July—October September—Nov.	Osmanabad town Mhaismal
Nicotiana glauca Grah N. repanda Lehm	December—Mar.	Aurangabad
N. repanda Lenm Physalis minima Linn	September-Oct September-Oct	Aurangabad Osmanabad
·	septemoer-oet	Osmanabau
Petunia hybrida Ulm	JanuaryMarch	Aurangabad
Solanum incanam Linn S. indicum Linn	June—September	Osmanabad
C migrum Linn	September—Nov. September-Oct	Osmanabad Osmanabad
S. sisymbrifolium Lam.	July —September	Osmanabad
S. verbascifolium Linn.	September—Jan.	Osmanabad
Withania somnifera Dunn	September—Jan.	Osmanabad
Family Scrophulariaceae:		
Antirrhinum majus Linn	September—March	Aurangahad
Dopatrium junceum Buch- Ham.	September—Jan.	Osmanabad
Limnophila racemosa Benth.	October-Nov	Aurangabad
Lindenbergia urticifolia Lehm.	August —Oct	Aurangabad
Mimulus gracilis R. Br.	August-September	Aurangabad
Russelia rotundifolia Cav	December—Jan.	Aurangabad
Sopubia delphinifolia Don Stemodia viscosa Roxb.	September-Oct.	Osmanabad
Stemodia viscosa Roxb. Striga angustifolia (Don.)		Osmanabad
Sald.	August—Jan	Aurangabad
S. gesneroides (Willd.) Vatke.	October-Jan	Aurangabad
Sutera dissecta (Del.) Walp.	November—Feb.	Osmanabad
Verbascum chinense Sant	September—Feb.	Osmanabad
<i>Veronica anagallis-aquatica</i> Linn.	September-Oct	Osmanabad
Family Orobanchaceae :		
Orobanche cernua Loef. var. nepalensis DC.	September-Oct	Osmanabad
Family Lentibulariaceae:		
Utricularia caerulea Linn U. stellaris Linn. f	September-Oct December-Jan	Osmanabad Parbhani
Family Bignoniaceae:		
Dolichandrone falcata Seem.	December-Mar.	Osmanabad
Doxantha angiscati Rehdr	December-Jan.	Aurangabad
Heterophragma roxburghii DC	December-Mar.	Aurangabad
Millingtonia hortensis Linn. f.	June —September	Aurangabad
Tecoma stans (Linn.) Seem		Osmanabad
Tecomalia capensis Spach	January—March	Aurangabad

ILOXA	nakani waa	
Name	Flowering season	Locality
Family Pedaliaceae:		
Martynia annua Linn	August—Oct	Osmanabad town
Sesamum -indicum Linn	September-Oct	Osmanabad
Family Acanthaceae:		
Andrographis echioides Nees	September-Oct	Osmanabad
	September-Oct	Mahur
Asystasia lawiana Dalz	September-Oct	Aurangabad Osmanabad town
	September-Oct	Osmanabad town
B. prionitis Linn Blepharis asperrima Nees	August—Oct	Aurangabad
B. molluginifolia Pers.	Oct.—Jan	Mahur
Calliaspidia guttata (Brend.) Brem.	December—Feb.	Parbhani
Decliptera micranthes Nees	December-Jan	Mahur
Dipteracanthus patulus Nees	July—December	Osmanabad
Dipteracanthus prostratus (Poir) Nees.	July—December	Osmanabad
Dyschoriste erecta (Burm.) O. Kuntze.	October—Jan	Aurangabad
Franthemum purpurascens News.	October—Jan	Mahur
Haplanthus verticillaris (Roxb.) Nees.	October-Jan	Mahur
Hemigraphis dura T. Anders	December—Feb.	Osmanabad
H. latebrosa Nees var Meyneana Brem.	December—Feb.	Osmanabad
Hygrophila obovata (Roxb.) Noss.	December-Jan.	Osmanabad
	September—Feb.	Osmanabad
Justicia betonica Linn.	October—Jan	Osmanabad
J. diffusa Willd	August-Nov	Osmanabad
J. gendarrusa Linn		Aurangabad
J. orhiculata Wall	August—Jan August—Nov	Aurangabad
J. prostrata Gamble	August—Nov	Osmanabad
J. quinangularis Koen	August-Nov	Aurangabad
J. vahlii Clarke	August—Feb	Aurangabad
Lepidagathissubarmata Gamble.	August—Dec	Osmanabad
Phaulopsis densiflora (Retz.) Sant.	November—Jan.	Parbhani
Rungia parviflora Nees	September-Jan	Mahur
R. repens Nees	July—Dec	Osmanabad
Thumbergia laevis Nees	August-Sept	Osmanabad
Strobilanthes callosus Nees Carria callosa	••	Ajantha hills, Aurangabad
Family Verbenaceae:		
Citharexyion subserratum Sw.	August-Oct	Aurangabad
Clerodendrum phlomides Linn.	January-Feb	Osmanabad
Duranta erecta Linn	October—Dec	Aurangabad
Holmskioldia sanguinea Retz.	October—Dec	Aurangabad
Phyla nodiflora (Linn.)	June—March	Osmanabad Aurangabad
Priva cordifolia (Linn. f.) Druce Tectona grandis Linn. f	September—Dec.	Aurangabad Osmanabad

Name	Flowering season	Locality
Stachytarphetajamaicensis (Linn.) Vahl.	December-Mar.	Aurangabad
Verbena bipinnatifida Nutt V. officinalis Linn Vitex negundo Linn	January-Feb February-March September—Jan.	Aurangabad Osmanabad Osmanabad
Family Lamiaceae (Labiatae):		
Anisomeles indica (Linn.) O. Rtze.	September—Nov.	Osmanabad
Coleus barbatus Benth Colebrookia oppositifolia Smith.	August—Oct	Aurangabad Dry hills
Geniosporum tenuiflorum (Linn) Merr.	September-Jan.	Osmanabad
Hyptis suaveolens Poit. Lavendula bipinnata (Linn.) O. Kuntze.	September—Jan. October—Jan	Osmanabad Osmanabad
Leonotis nepetifolia R. Br Leucas aspera Spr	October—Jan August—Oct	Osmanabad Osmanabad
L. biflora R. Br. L. cephalotes Spreng.	August—Oct	Osmanabad Osmanabad
L. stricta Benth.	August—Oct.	Aurangabad
L. urticifolia R. Br.	August-Oct	Aurangabad
Majorana hortensis Moench.	August—Oct	Aurangabad
Meriandra bengalensis Benth.	December-Jan	Aurangabad
Ocimum gratissumum Linn.	September-Oct	Osmanabad
Salvia plebeia R. Br	December-Jan	Osmanabad
Salvia splendens Bello	December-Jan	Aurangabad
Family Plantaginaceae:		
Plantago exigua Murr.	August-Sert	Aurangabad tow
Family Amaranthaceae:	olo, mol	
Achyranthes aspera Linn. var. porphyristachya Hook. f.	July—December	Aurangabad
Alternanthera pungens H. Bk.	June—February	Osmanabad
A. sessilies (Linn.) R. Br	August—Oct	Osmanabad
A. versicolor Regl	August—Oct	Aurangabad
Amaranthus caturus Heyne. A. dubius Mart. ex. Thell	August—Oct	Osmanabad
Amaranthus hybricu;Linn,SS cruentus thell var	August—Oct January—March.	Osmanabad Osmanabad town
paniculatus A. lividus Linn. ssp	August Ost	00
A maluannaidan	August—Oct July—October	Osmanabad town
A. spinosus Linn.	July—October July—September	Osmanabad town Osmanabad town
A. tricolor Linn.	Aug—Oct	Osmanabad
A. viridis Linn	July-February	Osmanabad
Cleosia argentea Linn	August—Feb	Osmanabad
Digera muricata Mart	August—Dec	Osmanabad town
Gomphrena celosioides Mart.	August—Feb	Aurangabad
G. globosa Linn	August—Oct	Aurangabad
Pupalia leppacea Mig	September—Oct.	Osmanabad
Family Caryophyllaceae:		
Polycarpaea Corymbosa Lam.	September—Dec.	Osmanabad

Name	•	Flowering season	Locality
Family Chenopodiaceae:			
Atriplex hortiensis Linn. Basella rubra Linn. Chenopodium album Linn. C. murale Linn.		August—Oct	Aurangabad Aurangabad Aurangabad Osmanabad Aurangabad
Family Lauraceae:			
Litsea polyantha Juss			Aurangabad Parasite on common hedge plant.
Family Polygonaceae:			•
Homalocladium platycladu Bailey.	m	December-Jan	Aurangabad
Polygonum flaccidum Messm P. glabrum Willd. P. plebejum R. Br.		October—Feb August—Oct December—Feb. September-Oct November—Jan. January-Feb	Nanded Osmanabad Osmanabad Aurangabad Osmanabad Aurangabad
Family Aristolochiaceae:			
Aristolochia bracteata Retz. A. indica Linn.		August—Oct August—Oct	Aurangabad Osmanabad
Family Loranthaceae:	14	13 20 T	
Viscum articulatum Burm. Dendraphthoe falcata Etting		February—April February—April	Aurangabad Aurangabad
Family Santalaceae: Santalum album Linn.	सद	Fobruary—April	Aurangabad
Family Euphorbiaceae:			
Acalypha ciliata Forsk. A. hispida Muell. Arg. A. indica Linn. A. lanceolata Willd. Baliospermum montanum Bl Breynia nivesa Spreng. Chrozophora prostrata Dala Givotia rottleyriformis Grifl Emblica officinalis Gaertn. E. phorbia coccinea Roth E. corrigioloides Boiss. E. cristata Heyoe E. dracunculoides Lamk. E. elegans Spr. E. fimbriata Heyne E. orbiculata Mig. E. prostrata Avt. E. rothiana Spreng. E. thymifolia Linn.	 z. f.	August-September June—April June—January July—January September-Oct. January-Feb. Hot season September-Oct. October—January July—October October—Jan. January—June September—Oct. December—Feb. August—Jan. July—October June—January	Osmanabad Aurangabad Osmanabad Osmanabad Common in dry hills. Osmanabad Marathwada Aurangabad Osmanabad

Name		Flowering seaso	n	Locality
E.zornioides Boiss. Jatropha gossypifolia Linn. J. curcas Linn. Phyllanthus fraternus Webs. P. maderas Patanai P. emblica Linn. Mallotus philippinensis Muell		August—Oct. Nov-Feb. Nov-Feb. Sept-Dec. Sept-Feb.		Aurangabad Osmanabad Osmanabad Aurangabad Aurangabad Sparse in forest
Sapium insigne Benth. Securinega leucopyrus Muell S. virosa Pax and Hoffm. Tragia cannabina Linn. f. T. montana Muell-Arg.		Jan-April Dec-Feb. Sept-Jan. Dec-Feb. Dec-Feb.		Aurangabad Aurangabad Aurangabad Osmanabad Parbhani
Family Urticaceae:				
Fleurya interrupta (Linn.) Gaud.	•	Aug-Oct.	••	Aurangabad
Ficus tsiela Roxb Girardinia zeylanica Dene. Holoptelia integrifolia Planch Streblus asper Lour.	1.	Cultivated Oct-Dec. March-April	•••	Aurangabad Aurangabad Aurangabad Common on day hills and river-sides.
Family Casuarinaceae: Casuarina equisetifolia Linn.		Jan-March		Aurangabad
Family Salicaceae: Salix tetrasperma Roxb.		March-May		Aurangabad
Family Ceratophyllaceae Cerotophyllum demersum Linn.	HZ4	Oct-March	• •.	Aurangabad
(Roxb.) Thro.	•	Jan-March Jan-Feb.	•••	Parbhani Nanded
Pers.				
Family Orchidaceae: Eulophia ramentacea Lindl. Habenaria marginata Coleb. H. platyphylla Spreng. Zeuxine strateumatica Schlect		Dec-Jan. Sept-Oct. Sept-Oct. Dec-Feb.		Aurangabad Osmanabad Osmanabad Aurangabad
Family Amaryllidaceae:				
The same of the same of the same	•••	Sept-Oct. March-April Sept.	•••	Aurangabad Aurangabad Aurangabad
Family Dioscoreaceae:				
Dioscorea alata Linn. D. bulbifera Linn. D. hispida Dennst.	•••	Aug-Oct. Sept-Oct. Sept-Oct,	••	Aurangabad Aurangabad Aurangabad

Name	Flowering season		Locality
Family Liliaceae:			
Asparagus racemosus Willd var. javanicus Baker.	July-Oct.	••	Osmanabad
Chlorophytum bharuchae Ans. Ragh, et. Hem.	June-Aug.	••	Aurangabad
C. capense O. Kuntze	Sept-Jan.		Aurangabad
$C. laxum R. Br. \dots$	June-Aug.		Aurangabad
C. tuberosum Baker	June-Aug.		Aurangabad
Dipcadi montanum Baker	June-July	• •	Aurangabad
Gloriosa superba Linn	Sept-Oct.		Aurangabad
Iphigenia indica Kunth	July-Aug.		Aurangabad
I. pallida Baker	July-Aug.	• •	Aurangabad
Urginea coromendeliana Hook, f.	March-April	•••	Aurangabad
Aloe vera Linn			Aurangabad
Family Pontedariaceae:	Cant		Nanded
Monochoria vaginalis Preses	Sept.	• •	Manucu
Family Commelinaceae:			
Amischophacelus axillaris (Schultz) Rao.	Sept.	. ••	Nanded
A. cucullata (Kunth) Rao	Sept-Oct.		Osmanabad
Commelina bengalensis Linn.	Sept-Oct.	• •	Aurangabad
C. nudiflora Linn	Sept-Oct.		Osmanabad
= Murdania nudiflora.	and the last		
C. kurzii Clarke	Sept-Oct.	• •	Aurangabad
Cyanotis cristata Schult.	Sept-Oct.	• •	Osmanabad
C. fasciculata Schult.	Sept-Oct.	• •	Aurangabad
C. tuberosa var. adseodens Cl.	July-Aug.	••	Osmanabad
Family Typhaceae:			
Typha angustata Aub. Bory	• •		Aurangabad
Family Palmae:			
Phoenix sylvestris Roxb	Jan-March	••	Osmanabad
Family Araceae:	Man Tuna	9	Aurangabad
Amorphophallus sylvaticus Kunth.	May-June		_
Cryptocorcne retrospiralis Kunth.	DecFeb.		Aurangabad
Family Alismaceae:			
Lemna paucicostata Hagel Wolffio arrhiza Wimm	Oct-March Sept-March	••	Osmanabad Osmanabad
Family Alismaceae:			
Limnophyton obtusifolium (Linn.) Mig.	Dec-Feb.	••	Nanded

Name	Flowering season		Locality
Family Naiadaceae:			
Aponogeton natans (Linn.) Engl. et. Krausel.	Jan.	- •	Nanded
Najas graminea Del	Sept-March		Osmanabad
Potamogeton nodosus Poir.	Oct-Feb.		Nanded
P. pectinatus Linn	Oct-Jan.		Parbhani
Zannichellia palustris Linn. ssp pedicellata.	Sept-Oct.	• •	Aurangabad
Family Eriocaulaceae:			
Eriocaulon lun ulaefolium Mart.	Sept-Oct.		Aurangabad
Family Cyperaceae:			
Bulbostylis barbata Kunth	Aug-Oct.		Osmanabad
Cyperus alopecuroides Roth.	Sept-Oct.		Osmanabad
C. aristatus Roth	Sept-Oct.		Osman abad
C. compressus Linn	Sept-Oct,		Aurangabad
C. corymbosus Roth.	Sept-Oct.		Osmanabad
C. difformis Linn	Aug-Oct.		Osmanabad
C. elusinoides Kunth	Sept-Oct.		Osmanabad
C. esculentus Linn.	Sept-Oct.		Osmanabad
C. exaltatus Retz	Sept-Oct.	• •	Osmanabad
C. globosus All	Sept-Oct.		Aurangabad
C. hyalinus Vahl	Sept-Oct.		Nanded dist.
C. pangorei Roth.	Sept-Oct.		Osmanabad
C. pumilus Linn			Osmanabad
C. rectangularis (Kuk.) Benn.	Sept-Oct.		Osmanabad
C. rotundus Linn	Sept-Oct.		Osmanabad
C. teneriffae Poir	Sept-Oct.		Osmanabad
Eleocharis plantaginea R. Br.	Sept-Oct.		Aurangabad
Eriophorum comosum Wall	Oct-Jan.		Aurangabad
Fimbristylis complanata Link.	Sept-Oct.		Osmanabad
F. diphylla Vahl	Sept-Oct.		Osmanabad
F. dichotoma Vahl	Sept-Oct.		Aurangabad
F. ferruginea Vahl	Sept-Oct.		Aurangabad
F. junciformis Vahl	Sept-Oct.		Osmanabad
F. monostachya Hessk	Sept-Oct.		Osmanabad
F. schonoides Vahl	Sept-Oct.		Osmanabad
F. tetragona R. Br	Sept-Oct.		Osmanabad
Fuirena walichiana Kunth	July-Oct.		Osmanabad
Kyllinga triceps Roth	July-Jan.		Osmanabad
Scirpus corymbosus Heyne	Sept-Oct.		Aurangabad
S. squarrosus Linn	Sept-Oct.		Osmanabad

6. LIST OF PLANTS FROM AJANTHA HILLS

Ajantha are low trap hills with the world famous caves having sculpture and paintings. Their features and expressions are exquisite and are famous world over especially the roof and wal coloured paintings and the scenes from the life of Buddha.

सत्यमेव जयत

Family Violaceae Viola tricolour Linn.

Cochlospermoceae Cochlospermum gossipium DC.

Polygalaceae Polygala fullothrix Dunn.

Elatinaceae
Bergia ammanoides Heyne.

Malvaceae: Sida rhomboidifolia L.

Sterculiaceae

Helicteris isora L.

Oxalidaceae
Biophytum sensitivinum (L.) DC.

Tropaeolaceae Tropaeolum sp.

Simarubuceae
Ailanthus excelsa Roxb.

Burseraceae

Boswellia serrata Roxb.

Meliaceae

Azadiracta indica A. Juss.

Rhamnaceae
Zizyphus globerrima Sant.
Z. xylopyra Willd.

Ampelidaceae

Leea indica (Burm.) Merrill.

Anacardiaceae

Lannea grandis (Hoult) Merrill.

Fabaceae Papilionaceae
Crotalaria filiceps Benth.
C. medicagirea Lamk.
Psoralea corylyfolia L.
Mucuna prurita Hook.
Dalbergia latifolia Roxb.

Caesalpinaceae

Hardwickia binata Roxb.

Mimosae

Mimosa hamata Willd.

Acacia ferruginea DC.

A. tomentosa Willd.

Combretaceae

Terminalia chebula Retz.

T. arjuna Wight.

Anogeissus latifolia Wall.

Onagraceae

Ludwigia parviflora Roxb.

Rubiaceae

Anotis lancifolia (Dalz.) Hook.

Compositeae

Vicova tomentosa Can.

Oleaceae

Nyctanthes arbor-tristis Linn,

Apocynaceae

Wightia tinctoria Br.

W. tomentosa Roem and Schultez.

Convolvulaceae

Argyreia cunneata Ker Gawl.

Solanaceae

Physalis minima L.

Scrophulariaceae

Buchnera hispida Buch. Ham. Sopubia delphinifolia (Roxb.) G. Den.

Bignoniaceae

Dolichondron falcata Seem.

Verbenaceae

Vitex negundo L.

Labiatae

Lavendula burmanii Benth,

Euphorbiaceae

Euphorbia rothiana Spr.

Bridelia retusa Spr.

Hypoxydaceae

Hypoxis aurea Lour.

Curculigo orchioides Gaertn.

Amaryllidaceae

Crinum asiaticum L.

Dioscoreaceae

Dioscorea oppositifolia

D. triphylla.

Commelinaceae

Cyanotis tuberose (Roxb.) Schultez.

Gramineae

Cymbopogon nardus (L.) Rend.

7. PLANTS OF KANNAD GHAT AND REGION AROUND

Family Ranunculaceae

Clematis gouriana Roxb. ex DC.

C. wightiana Wall.

Menispermaceae

Tinospora cordifolia (Willd.) Miers

सत्यमव जयत

Capparidaceae

Capparis horrida Linn.

C. spinosa L.

Flacourtiaceae

Flacourtia montana Graham.

Cochlospermaceae

Cochlospermum gossypium DC.

Caryophyllaceae

Polycarpea corymbosa (Linn.)

Lamk.

Elatinaceae

Bergia ammanioides Heyne ex Rath.

Malvaceae

Hibiscus micranthus L.

Kydia calycina.

Thespesia lampas Dalz and

Gibs.

Tiliaceae

Triumfetta pillosa Rath.

Malpighiaceae

Hiptage benghalensis (Linn.)

Kurz.

Balsaminaceae

Impatiens sp.

Meliaceae

Cippadesa baccifera (Roth)

Mia.

Azadiracta indica Jassu.

Melia axadirecta L.

Heynea triguga Roxb.

Suietenia mohagonii Linn.

Rhamnaceae

Zizyphus rugosa Lamk.

Zizyphus glaberrima Sant.

Z. xylopcarpa Willd.

Z. oenoplea Mill.

Ventilago madraspatana .. June-Sept,

Gaertn.

Ampelidaceae

Leea indica (Burm.) Merrill.

L. sambucina Willd.

Anacardiaceae

Buchanania lanzan Spreng .. Dec-Jan.

Mangifera indica L.

Fabaceae (Papilionaceae)

Crotolaria medicaginea Lamk.

Smithia sensitiva Ait.

Desmodium triquetrum (L.) DC.

D. rotundifolium Baker.

Mucuna prurita Hook.

Dalbergia latifolia Roxb. .. Au -Oct.

Uraria alopecuroides Wt.

Caesalpiniaceae

Wagatea spicata Dalz.

Bauhinia racemosa Lamk.

B. vahlli W. and A.

Hardwickia binnata Roxb.

Mimosae

Acacia feruginea DC.

A. tomentosa Willd.

Combretaceae

Terminalia bellerica (Gaertn.)

Roxb.

T. chebula Retz.

T. arjuna Wight.

T. tomentosa Willd.

Anogeissus latifolia Walli.

Enocarpus latifolia Roxb.

Calycopteris floribunda (Roxb.)

Ďamk.

Melastromaceae

Melastoma malbaricum Linn.

Osbeckia truncata Don.

= O. zeylanica Graham.

Lythraceae

Ammania rotundifolia Buch

Ham.

Rotalia rotundifolia Buch.

Ham.

Onagraceae

Jussiaea suffruticosa Linn.

J. repens Linn.

Ludwigia parviflora Roxb.

Passifloraceae

Passiflora foetida Linn.

Cucurbitaceae

Trichasanthes bracteata

(Lamk.) Wight.

Melothria heterophylla Linn.

M. triphylla Linn.

Umbelliferae

Pimpinella laterifolia Dalz et

Cubbs.

Rubiaceae

Ixora arborea Roxb.

I. parviflora Vahl.

Vangurea spinosa Roxb.

Compositeae (Lamiaceae)

Blumea virens DC.

Primulaceae

Anagalis arvensis Linn.

var. caerculea Gren and Codr.

Ebenaceae

Maba nigricans Roxb.

Oleaceae

Jasminum malabricum Wight. =J. latifolium Graham.

Olea dioica Roxb.

Apocynaceae

Wrightia tomentosa Roem and Schultz.

Alstonia scholaris (Linn.) R. Br. = Echites scholaris Linn.

Asclepiadaceae

Hemidesmus indicus (Linn.)

R. Br.

Hoya wightii Hook. =Hoya pallida Dalz.

Gentianaceae

Exacum pumilum Griseb.

E. bicolor Roxb.

Fimanthrum indicum (Linn.)

Griseb.

Swertia minor (Griesb.)

Knabl.

Hydrophyllaceae

Hydrolea zeylanica (Linn.) Vahl.

Boraginaceae

Paracarium malabiricum Clarke.

Solanaceae

Physalis minima Linn.

Scrophulariaceae

Dopatrimum juncum (Roxb.)

Buch. Ham.

Buchnera hispida Buch-Ham.

Sopubia delphinifolia (Roxb.)

G. Doz.

Lentibulariaceae

Utricularia reliculata Smith.

U. graminifolia.

Bignoniaceae

Dolichondron falcata.

= D. laurii Graham.

Heterophragma chelonoides DC.

Sterospermum personatum

(Hossk) Chatteriee.

Acanthaceae

Andrographis echinoides Nees.

Justicia simplex D. Don.

Verbanaceae

Callicarpa tomentosa (Linn.) Murray.

Labiateae

Lavendula burmanii Benth. Orthosiphon tomentosum

=0. glabratus Benth.

O. rubicundus.
Pogostemon parviflorus Benth.
Leucas ciliata Benth.

Loranthaceae

Dendrophthoe falcata (Linn.) Etting = Loranthus longiflorus Desv.

Viscum nepalense Spreng. V. articulatum Hook. = V. attennuatum DC.

Santalaceae

Byris wightiana Wall. = O. arborea Wall.

Euphorbiaceae

Euphorbia rothiana Spr.
Bridelia retusa (Linn.) Spreng.
Glochidion hoheniackeri Redd.
=Bridelia sinica Graham.
Mallotus aures-punctatus
(Dalz.)
Crivotia rettlemiformis Griff.

Crivotia rettlemiformis Griff.
Coenocephalus niveus Wight.
= Boehmeria romiflora Gr.
Capsi.

Moraceae

Ficus hispida Linn.
Cavellia oppositifolia Gasp.
= Ficus appositifolia Willd.

Salicaceae Salix tetrasperma Roxb.

Hydrocharitaceae Vallisneria spiralis Linn.

Orchidaceae

Eulophia nuda Lindl. Habenaria rariflora Lindl. H. marginata Caleb.

Zinziberaceae

Curcuma amada Roxb. .. June-July. C. rubescens Roxb. .. June-July.

Amaryllidaceae

Crinum moorei Hook f.

. March-April.

Gramineae

Bambusa arundiana Retz.

B. arundinaceae Klein.

B. stricta Lodd.

Sporobolus diander Beauve

S. indicus (Linn.) R. Br. Apluda aristata Linn.

=A, varia Hook.

Eragrostis latifolia Wight.

E. viscosa Trim.

E. tenella R. and S.

8. PLANTS OF KINWAT

•••	
Name	Flowering Season
Family Olacaceae:	
Olax scandens Roxb	July-February
Otax seataens Roxo	July-1 Columny
Ampelidaceae:	
Cissus woodrowii Sant	June—September
=Vitis woodrowii Stapf.	
Caesalpinaleae:	
Bauhinia lanzan Spreng	December-January
Alysicarpus lamosus Edgens	September-October
Crotolaria sericea Retz	
Dalbergia paniculata Roxb	
Roynchosia capitata DC	September-October
Uraria alopecurodes Wt	August—October August—October
U. hamosa Wall	August—October
Combretaceae:	
Terminalia paniculata L	February-March
	•
Lythraceae:	
Rotalia mexicana Chain	September-October
Cucurbitaceae:	
Melothria laterophylla Cong	September-October
Umbelliferae:	
Pimpinella latifolia	September-October
Dalz et Gibbs.	•
-	
Rubiaceae:	
Adina cordifolia Benth, and Hook, f	September-October
Gardenia latifolia Ait	
Hamiltonia suaveolens Roxb	
Knoxia corymbosa Willd	
Otaentanata offinis DC	September-October
Campanulaceae:	
Labelia heyneana R. and S	September—January
Ebenaceae:	
Diospyros tomentosa Roxb	July-August
Diospyros iomeniosa itoros	July Mugust
Loganiaceae:	•
Hitreola oldenlandioides Wall	September-October
Gentianaceae:	
Canscora decuminata R. and S	Sertember-November
A-127—21-A.	

Name	Flowering Season
Convolvulaceae:	
Lettsomia setosa Roxb	August—January October—February September—January
Solanaceae:	
Lindernia ciliata (Colsm.) Perin L. crustacea (L.) Muell	September-October September-October
Acanthaceae:	
Barleria montana Nees	August—October
Labiatae:	
Orthosiphon rubicundus	July—October September-October
Euphorbiaceae. Euphorbia pincnostegia Boiss, var. Laxa Boiss.	September-January
Phyllanthus simplex Don. P. arinaria Linn.	August—December
Urticaceae :	4 925
Trema orientalis Planch	April-May
Orchidaceae: Vanda tesellata Hook	April—June
Zingiberaceae:	
Curcuma amanda Roxb	June-July June-July
Amaryllidaceae:	
Crinum moorei Hook	March-April
Araceae:	
Typhonium trilobetum Schott	June-July
Sagittaria guayenensia (D. Don) Buchen	September-October
Alismoceae:	
Tenagocharis latifolia (Den.) Duchen	September-October
Cyperaceae: Fimbristylis quinqueangularis Kunth	September-October

Norm:—References to the Flora of Marathwada are given on page No. 367. A-127—21-B.

SECTION B-FLORA OF KHANDESH

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SECTION B-FLORA OF KHANDESH

1. GEOGRAPHIC SITUATION OF KHANDESH

Khandesh comprises two districts of Dhule or West Khandesh and Jalgaon or East Khandesh. It lies in the valley of Tapi and is separated from Western Maharashtra by the hills of Laling and Silbari and their extensions. It lies above the mean level at an altitude of about 700 meteres. Ajantha hills are to its South. Satpuda ranges cross it parallel from east to west. It is adjacent to Nasik, Aurangabad and Buldhana districts. The valley of Khandesh is broad. It is plain and rises gently towards west, there being mountains on its both sides, Ajantha and Satpudas. The hills are mostly formed by the Deccan traps and so are the soils. The monsoons are long, continuing from June. They last till October. The hill sides are covered with dense vegetation, but the country between Satpuda ranges is plain.

The flora of Khandesh with special reference to Satpudas has been worked out by Mahabale and Karnik (1959) and Karnik (1955, 1956). The list of species collected by them is given here. It will be seen from this list that there are very few moist humid species. They are mostly dry deciduous or scrubby plants. This is because the climate of Khandesh suffers from extremes. Rains are confined to rainy season, winter very cold and summer very hot. Soils are alluvial on the banks of rivers and black cotton soils elsewhere. Once the Tapi is crossed the black cotton soils appear again. They are deep, sticky, often calcarious. Analysis of typical soil samples in Khandesh is given in Analysis of Soils in Khandesh.

General topography of Khandesh is partly plain and partly wavy due to Satpudas. Authors like Dalzell and Gibson (1861), Talbot (1906), Hooker (1904), Blatter and McCann (1935) have made passing references to the plants of Khandesh, but there had been no comprehensive account of them. Cooke (1904-1908) describes only a few plants from Khandesh in the Flora of the Bombay Presidency. It is obvious that many places in Khandesh need to be explored. There is a very old paper by Moghe (1921) on Betul Satpudas, wherein he enumerated the species there. The hills here in Khandesh are of amygdoloidal trap flows or of softer variety of Deccan trap. Sedimentary beds are often calcarious. Toranmal hill plateau is of the Deccan trap origin. On the top of it there is only a small red clay layer. In summer months hot winds blow every where. Annual rainfall is between 731.8 mm at Chopda and 767.9 mm at Yawal. It is slightly more about 789.7 mm at Taloda. Sometimes Raver gets more than 38" (965 mm) of rain whereas Akrani and Toranmal get as low as 16-13" (406-340 mm) generally. Humidity is highest in the months of July and August. Mean annual maximum temperature at Raver 99.56°F, Yawal 101.79°F., Chopda 93.31°F, Shirpur 100.49°F and at Shahada 95.26°F. Dust storms occur occasionally in July, August and October.

Satpudas start from Mahadev hills from Chauragarh in Madhya Pradesh (Alt.4200') (1276 mm) and extend westwards to Burhanpur, and Nimar in Madhya Pradesh and thence to Khandesh.

Broadly speaking eastern region of Satpudas is rich in vegetation having some humid and semi-evergreen species. The middle region of it lies in Khandesh districts and has many deciduous or mixed deciduous species. Western region has only dry scrub in Madhya Pradesh. It breaks into a low woodland or scrub elsewhere.

2. CLIMATE OF DHULE (WEST KHANDESH) DISTRICT AND JALGAON (EAST KHANDESH) DISTRICT:

DHULE DISTRICT (WEST KHANDESH)

Climate on the whole is dry, except during south-west monsoons which begin in June and last till about September-October and even upto November sometimes. The average rainfall of the district is 674mm (27"). It is heaviest in the ghat region towards north-west and in Satpuda ranges. For example, Navapur at the north western border gets 1097 mm (44") rain. 88 % of the rainfall is due to south-west monsoons, it being heaviest in July. Thunder showers are received in post-monsoon period. Once in 50 years rainfall is less than normal and also twice or thrice more, especially in Navapur and Nandurbar.

The annual rainfall for the whole of Dhule district is 674 mm (27") on an average. Rainy days in the year are 42. The temperature in the district begins to rise in the latter part of February to May. May is the hottest month. After the monsoons have stopped in October, temperature begins to rise again in October till November and then goes down.

At Nandurbar the highest temperature is 115°F in May, and the lowest 45.8°F in January. Relative humidity in monsoon is 70 % and in other months 20-25 %. Summer winds blow from south-west to west. Cold waves strike with cold winds from the North. The monsoon winds are variable in directions both at day and night. Relative humidity is 47 % to 35 % when daily mean maximum temperature is around 30 °C. but in April it could be as high as 40°C. The corresponding minimum is 16°C to 25.8°C.

The first authentic record of Khandesh plants is to be found in Cooke (1904-1908) The Flora of Bombay Presidency including Gujarat, Sindh and Karnatak. In this work he has described for the whole of Bombay Presidency 2530 species belonging to 969 genera spread over 142 families. Here he mentioned only 68 species belonging to 46 genera and 33 families as occurring in Khandesh due to meagre collections made in Khandesh. Localities mentioned therein are vague and often given in the broadest terms such as "Khandesh", common throughout India or "the Bombay Presidency" with no special reference to Khandesh. This is unhelpful.

JALGAON DISTRICT (EAST KHANDESH)

The climate is dry except in monsoon which appears in June and lasts till September. But it may continue in October. Annual mean rainfall is between 740.7 mm. The average rainy days are 45, but 48 at Jamner, 42 at Chopda, Amalner and Parola. Rain is fairly well distributed. December is the coldest month. Heaviest rainfall is in July, sometimes in September. The latter proves very helpful to Rabi crops.

Temperature.—Annual maximum temperature is about 47 °C and minimum 11.9°C. Relative humidity varies from 60.30 to 86.65 %. At Jalgaon wind speed on an average is 11.1 km per hour. Jalgaon is the hottest place in the district.

Soils are alluvial on the banks of river, elsewhere there are black cotton soils derived from traps. They are deep with a fair amount of calcium. Some soils give a Saline reaction, particularly soils of dry deciduous forests of *Tectona grandis* in Yawal range.

There are hot water springs at Unabdev near Chopda in Jalgaon district, but its algal flora or radio-activity have not been studied.

There are only dry deciduous forests in Satpudas in Khandesh.

Composition of Dry deciduous forests and their soil profiles are given below.

Subsidiary Edaphic type: Hardwickia binata-Anjan forest.

Edaphic climax unit. Hardwickia binata facies

Locality: -Satpuda forest.

Station.—(289 Mtrs.) Pal (Raver Range).

Height.—95° Altitude.

Relief.—Hill slopes.

Drainage condition.—Good

Sub-soil water table.—Fairly deep.

Floristic composition:

- I. Hardwickia binata. Anogeissus latifolia, Boswellia serrata, Acacia catechu, Terminalia tomentosa, Pterocarpus marsupium, Dalbergia latifolia.
 - II. Gymnosporia montana, Zizyphus rugosa.
 - III. Butea frondosa, Apluda varia, Andropogon contortus.

Horizon	Depth in inches	Description	Sample depth.
I	0—10	Dark brown soil, penetrated by roots, dry, of trees, pH 6.2.	9—10
II	10—20	Redaish brown, stony, compact pH-5.4.	10—20
111	2027	Red stony, compact with few roots, pH 5.2.	2027
IV	27—35	Blackish grey with reddish tinge, compact pH 5.0.	27—35
V	35—50	Blackish grey, compact, plenty with calcareous nodules pH 7.4.	3550
	Below 50	Murum.	

3. SOIL PROFILES OF DRY DECIDUOUS FOREST OF TECTONA GRANDIS (OR DRY TEAK TIMBER FOREST)

Teak or Tectona grandis (Timber forest)

Adina cordifolia Association

Locality-Satpuda Range

Station-Yawal (374 mtr.)

Height-1230' altitude

Relief-Hill slopes

Drainage condition-Good

Sub-soil water table-Deep

Floristic composition:

- I. Tectona grandis, Adina cordifolia, Terminalia tomentosa, Mitragyna Parvifolia, Boswellia serrata, Ougeinia Cojeinensis, Anogeissus latifolia, Dalbergia latifolia, Pterocarpus marsupium, Diospyros melanoxylon.
- II. Dendrocalamus strictus, Andropogon halepensis

Horizon	Depth in inches	Description	Sample depth
(1)	(2)	(3)	(4)
I	0-71	Brown-black penetrated by roots, dry, granular, pH 4.0	0-71
11	71-18	Deep black penetrated by roots, wet, planty, pH. 5.6 71-18	
Ш	18—26	Greyish black, compact, wet, platy, small fragments 18-26 of disintegrated trap, pH 5.4	
ΙV	26—37	Compact, grey, brown, nodular pieces of lime- stones, small pieces of disin egrated trap, pH 6.2	
v	37-48	Yellowish-chocolate brown calcarcous, pH 7.2	3748
	Below 48	Murum.	

4. PLANTS OF SATPUDAS IN KHANDESH AND ADJOINING REGION

सत्यमव जयत

Name

Locality

RANUNCULACEAE

Clematis smilacifolia Wall

Akrani.

DILLENIACEAE

Dillenia pentagyna Roxb.

.. On slopes of Satpudas.

ANNONACEAE

Annona squamosa Linn.

Plateau of Toranmal, Raver, Shirpur, Chopda ranges.

Miliusa tomentosa (Roxb.) Sinclair = Saccopetalum tomentosum Hook, f. and Thoms.

Bund of Toranmal Lake.

PAPAVERACEAE

Argemone mexicana tinn.

Shirpur, Chopda, Yawal ranges.

CAPPARIDACEAE

Cleome viscosa Linn.:

Shirpur, Chopda, Yawai ranges.

Cleome chelidonii Linn. ... Ranipur.

Cleome simplicifolia (Comb.) Raver range.

Hook. f. and Thoms.

Gynandropsis gynandra (Linn.) Brig.

=Gynandropsis pentaphylla DC. Capparis decidua (Forsk.):

. Akrani.

Cappuris zeylanica Linn. (non In Betul also. C. zeylanica HK. f. and Thoms.)

= Capparis horrida Linn.

Name Locality BIXACEAE Cochlospermum religiosum Toranmal. (Linn.) Alston. VIOLACEAE Hybanthus enneaspermus Linn. .. Betul. =Viola-enneasperma Linn. Ionidium heterophyllum Vent. FLACOURTIACEAE Flacourtia occidentalis Hook. f. . . Akrani. Girna River-Jalgaon, Padmalaya. =Flacourtia ramontchi L. Herit Flacourtia indica (Burm.) Merr. Sitaki Nahani, Toranmal Plateau. .. Raver range. Flacourtia sepiaria Roxb. PORTULACACEAE Beds of River Aner and Arunavati. Portulaca oleracea Linn. .. Sandy beds-Arunavati River. Portulaca quadrifida Linn. TAMARICACEAE .. Bank of Aner River. Tamarix dioica Roxb. **GUTTIFERAE** Garcinia spicata (W. and A.) Behind Forest Dak Bungalow, Akrani. Hook, f. MALVACEAE .. Near Forest village, Akrani. Sida veronicaefolia Lamk. =S. humilis. .. Lalmati, River Range. Sida spinosa Linn. Akrani. Kydia calycina Roxb. Abutilon graveolens Wight and Akrani. Arn. सत्यमव जयत Urena lobata Linn. =Urena sinuata Linn. In clearings of Pal and Raver range. In clearings, Shirpur range. Hibiscus hirtus Linn. Near Ranipur Forest Depot, Hibiscus lampas Cav. =Thespesia lampas Dalz. and Yawal range, Shirpur range. On steep slopes of Akrani. Ceiba ventranda (L) Gaertn. = Eriodendron anfractuosum DC. Dhadgaon. **BOMBACACEAE** Salmalia malabarica (DC.) Schott Akrani, common in Raver, Shirpur, Chopda and Yawal ranges, Toranmal—on steep slopes. and Endl. =Bombax malabaricum DC. =Gossampinus malabarica (DC.) Alston. **STERCULIACEAE** .. Toranmal plateau, Raver, Yawal Sterculia urens Roxb. Akrani, Ajantha ranges, on steep rocky ledges. Akrani—on lower slopes. Sterculia villosa Roxb.

Shirpur range.

Firmiana colorata (Roxb.) R. Br.

-Sterculia colorata Roxb.

Locality

Helicteres isora Linn. .. On Pal, Toranmal plateau and Raver, Shirpur, Chopda, Yawal ranges, Akrani behind the Forest Dak Bungalow.

TILIACEAE

Grewia tiliaefolia Vahl. .. Toranmal plateau and Raver, Virapur, Chopda, Yawal ranges.

Grewia pilosa Lam. .. Shirpur, Akrani, Taloda, Shahada ranges.

Triumfetta pilosa Roth ... Akrani.
Corchorus capsularis Linn. ... Akrani.

RUTACEAE

Aegle marmelos Correa .. Raver, Shirpur, Chopda, Yawal,
Panch Pandava ranges, beside
Shiva's temple Padmalaya.

Fagara budrunga Roxb. ... Akrani on the slopes of Forest

=Zanthoxylum budrunga DC.

Dak Bungalow.

Zanthoxylum rhetsa (Roxb.) DC.

=Fagara rhetsa Roxb.

Feronia limonia (Linn.) Swingle Akrani, Padmalaya, Raver,

=Limonia acidissima Linn. Chopda, Shirpur, Betul.

=Schinus limonia Linn. Toranmal plateau.

SIMARUBACEAE

Balanites aegyptiaca (Linn.) Delile

also in Betul.

Balanites roxburghii Planch. .. Taloda near forest depot.

Ximenia aegyptiaca Linn. .. Jalgaon on banks of Tapi river.

Ximenia aegyptiaca Linn. =X. americana.

Ailanthus excelsa Roxb.

... Toranmal plateau near the smaller lake, Raver, Chopda, Yawal ranges, Jalgaon beside G. P. C. and other places, Betul.

Yawal Range, Akrani, Padmalaya;

BURSERACEAE

Boswellia serrata Roxb. .. Teak pole jungles, Khandesh,

Satpuda, Toranmal plateau, Raver, Shirpur, Chopda, Yawal ranges, Akrani on the slopes.

Commiphora mukul Hook ex Stocks.

=Balsamodendron mukul Hook ex Stocks.

ex Khandesh and also in Betul Satpuda, Raverrange near Lalmati.

Garuga pinnata Roxb.

. Khandesh, Raver, Chopda, Shahada, Taloda ranges, Akrani, Langada-Amba.

MELIACEAE

Azadirachta indica A. Juss. .. Khandesh.

Melia azadarach Linn.

Pal, Toranmal plateau, Raver, Yawal, Shirpur, Chopda, Akrani, Raver, Chopda ranges,

Akrani.

Chloroxylon swietenia DC. . . Khandesh, Shirpur, Chopda, Taloda ranges.

Locality

Soymida febrifuga (Roxb.) A. Juss. Khandesh jungles, Raver, Taloda-Shahada ranges, Akrani.

Toona ciliata Roem. = Cedrela toona Roxb. Taloda range.

Yawal,

ranges.

CELASTRACEAE

Gymnosporia spinosa (Forsk.) Fiori.

= Gymnosporia montana Benth Celastrus senegalensis Lamk.

Khandesh. Toranmal plateau near the smaller lake, Akrani on slopes, Padmalaya.

RHAMNACEAE

Zizyphus mauritiana Lamk.

=Zizyphus jujuba Lamk.

Zizyphus oenoplia (Linn.) Mill

Betul, Toranmal plateau, Yawal, Akrani, Padmalaya, on the banks of river Vaghur.

Taloda,

Chopda, Shahada

Zizyphus rugosa Lamk,

Zizyphus xylopyra Willd.

Toranmal plateau, Yawal range Panch-Pandavas, Akrani.

.. Khandesh jungles, Betul, Toran-

mal plateau, Raver,

Toranmal plateau, Yawal range Akrani.

AMPELIDACEAE

Cissus elongata Roxb. = Vitis elongata Wall.

Cissus repanda Vahl. = Vitis repanda Wight and Arn.

Shirpur, Chopda, Taloda ranges, Ranipur, Langada-Amba, Lalmati.

Khandesh, Toranmal plateau. Shahada range, Akrani.

SAPINDACEAE

Schleichera oleosa (Lour.) Oken = Schleichera trijuga Willd.

Khandesh, Shirpur, Taloda. Shahada, Akrani, Ranipur, Laling, Dhule.

Raver Forest Dak Bungalow, Dodonaea viscosa (Linn.) Jacq. ... Bhusaval, Dhule, Jalgaon.

सत्यमव जयत

ANACARDIACEAE

Mangifera indica Linn.

Wild in Khandesh, Toranmal plateau, Raver, Shirpur, Chopda, Yawal, Shahada, Taloda ranges, Akrani, Langada-Amba, Panch-Panday, Ranipur.

Anacardium occidentale Linn. Lannea coromandelica (Houtt.) Merr.

=Lannea grandis (Dennst.) Engler,

Odina wodier Roxb. Buchanania lanzan Spreng.

= Buchanania latifolia Roxb.

Raver range.

Raver, Shirpur, Chopda, Yawal ranges, Langada-Amba.

Akrani.

Pal, Toranmal plateau in ravines ranges, Yawal range, Akrani, Sindva pass, Boradi, Langada-Amba.

Rhus myseonnsis Heyne

Semecarpus anacardium Linn. f. Spondias pinnata (Linn. f.) Kurz = Spondias mangifera Willd.

Locality

Boradi, Sindva pass, Raver range, Langada-amba.

Raver range. Akrani.

MORINGACEAE

Moringa oleifera Lamk.

— Moringa pterygosperma
Gaertn

Raver Forest Dak Bungalow.

LEGUMINOSAE

Heylandia latebrosa DC

Crotalaria sericea Retz. Indigofera linifolia Retz.

Psoralea corylifolia Linn.

Alysicarpus vaginalis (Linn.) DC

Alysicarpus bupleurifolius (Linn.) DC.

Desmodium gangeticum (Linn.) DC Chopda

Erythrina variegata Linn. Var. orientalis (Linn.) Merr.

=Erythrina indica Lamk. Erythrina suberosa Roxb. Erythrina stricta Roxb.

Butea monosperma (Lamk.)
Taubert.

=Butea frondosa Koenig. ex Roxb.

Butea superba Roxb. .

Pueraria tuberosa (Roxb.) DC

Phaseolus trilobus Ait.

Phaseolus semierectus Linn. Atylosis sericea Benth.

Cylista scariosa Roxb.

Dalbergia latifolia Roxb.

Dalbergia lanceolaria Linn.

Pal, Raver range, Shirpur range, Chopda range, Yawal range, Akrani.

Raver range, Burhanpur Fort.
Raver range, Chopda range,

Shahada range, Ellichpur.
Toranmal plateau, Raver range,
Gawilgad hills, Burhanpur

Fort, Ellichpur.

Khandesh jungles, Surat, Toranmal plateau, Ranipur, Akrani.

Raver range, Yawal range, Ellichpur.

Chopda range, Khandesh ravines, Shirpur range, Shahada range, Sindva pass, Boradi. Satpuda forests.

... Raver range, Burhanpur forest, Ellichpur.

Khandesh, Raver range.

Pal, Raver, Langada-Amba, Boradi.

(Lamk.) Khandesh, Pal, Raver, Shirpur,
Chopda, Yawal ranges,
nig. Langada-Amba, Sindva pass,
Boradi, Taloda range, Dhule.
Bal Payer range Shirpur range

Pal, Raver range, Shirpur range, Ranipur.

Toranmal plateau, Taloda range, Ranipur forest depot, near Suki river.

. Shahada range, Sindva pass, Boradi.

.. Akrani.

Raver range, Chopda range, Yawal range.

.. Pal, Raver range, Yawal range, Burhanpur Forest, Akrani.

Khandesh, Pal, Toranmal plateau, Raver, Shirpur, Chopda ranges, Ranipur, Langada-Amba.

.. Khandesh, Chopda range, Yawal range, Sindva pass, Ranipur, Langada-Amba.

Name	Locality
Dalbergia paniculata Roxb	Pal, Toranmal plateau, Shirpur range, Boradi.
Dalbergia rostrata R. Grah Pterocarpus marsupium Roxb.	Pal, Chopda range, Yawal range. Rajpipla hills, Taloda range, Akrani.
Cassia fistula Linn Cassia tora Linn	Pal, Raver range, Chopda range. Pal, Raver range, Akrani, Taloda range, Shahada range.
Cassia absus Linn	Toranmal plateau, Taloda range, Akrani—on slope.
Bauhinia vahlii Wight and Arn. Bauhinia purpurea Linn. Mimosa hamata Willd.	Akrani ravines. Khandesh, Akrani. Toranmal plateau, Shirpur range, Chopda range, Yawal range.
Acacia arabica Willd = A, nilotica	Khandesh jungles, Shirpur, Chopda, Yawal ranges, Boradi, Sindya pass.
Acacia ferruginea DC	Shirpur, Taloda, Shahada, Chopda, Yawal ranges, Boradi, Sindva pass.
Albizzia lebbeck (Linn.) Benth	Khandesh, Taloda range, Shirpur range, Ranipur.
Albizzia odoratissima (Linn. f.) Benth.	Khandesh, Shirpur range, Taloda range, Boradi, Sindva pass.
Albizzia procera (Roxb.) Benth. A. pinnata Willd	Akrani. Khandesh, Shirpur range, Shahada range, Sindva pass. Khandesh Jungles, Sindva pass.
Albizzia amara Boiv Abrus precatorius Linn	Toranmal plateau, Raver, Shirpur, Chopda, Yawal ranges, Akrani.
Adenanthera pavonia Linn.	Khandesh, Toranmal plateau, Akrani.
Caesalpinia bonduc ((Linn.) Roxb. =Caesalpinia bonducella (Linn.) Fleming.	Akrani. Shirpur range.
Hardwickia binata Roxb	Khandesh, Raver range, Chopda range.
Milletia auriculata Baker Neptunia triquetra Benth. Ougeinia oojeinensis (Roxb.) Hochreut.	Pal, Shirpur range, Raver range. Pal, Raver range. Khandesh.
=Ougeinia delbergioides Benth	Pal, Raver range, Taloda range, Shirpur range, Shahada range, Akrani.
Parkinsonia aculeata Linn	Betul, Yawal range, Shirpur range, Boradi.
Rhynchosia bracteata Benth. ex Baker.	Banks of Girna river.
=Rhichosia mollissima Dalz. Rhynchosia minima DC	Banks of Tapi. Akrani. Pal Jungles, Raver range, Langada-
Taverniera nummularia DC	Amba, Boradi. Khandesh, Toranmal plateau, Taloda range, Sindva pass.

FLORA OF KHANDESH	
Name	Locality
Tamarindus indica Linn	Khandesh Toranmal plateau, Taloda range, Sindva pass.
CRASSULACEAE	
Bryophyllum pinnatum (Lamk.) Oken.	Shirpur range.
Bryophyllum calycinum Salisb	Boradi Forest Dak Bungalow.
COMBRETACEAE	
Terminalia bellerica (Gaertn.) Roxb.	Khandesh, Taloda Range, Shirpur, Shahada Range, Akrani in the ravines.
Terminalia chebula Retz	Khandesh, Taloda range, Tajudin Vali in ravine on Panch- Panday Peak.
Terminalia arjuna Bedd Terminalia tomentosa Wight and Arn.	Taloda range. Khandesh, Taloda range, Shirpur range, Shahada range, Tajudin Vali in ravines.
Anogeissus latifolia Wall Quisqualis indica Linn	Raver range, Sindva pass. Akrani Forest Dak Bungalow.
MYRTACEAE	
Syzygium cumini (Linn.) Skeels = Eugenia jambolana Lamk	Khandesh, Pal. Toranmal plateau, Raver range, Taloda range, Shahada range, Boradi.
LECYTHIDACEAE	
Careya arborea Roxb	Khandesh, Taloda range, Shahada range, Langada- Amba, Panch-Pandav, Akrani in ravines.
LYTHRACEAE	
Woodfordia fruticosa (Linn.) Kurz. =Woodfordia floribunda Salisb	Khandesh. Toranmal plateau, Taloda range, Boradi.
Lagerstroemia parviflora Roxb	Taloda East range, Sindva pass, Panch Pandav, Akrani.
SAMYDACEAE	p, rainer rainary, /ikiaiii.
Casearia glomerata Roxb	Khandesh, Taloda range in the ravines.
CARICACEAE	

CARICACEAE

Cultivated in Raver range, in the Forest Dak Bungalow, Carica papaya Linn. Raver.

BEGONIACEAE

Begonia concanensis DC ... Akrani in the ravines.

CACTACEAE

Opuntia elatior Mill .. = Opuntia dillenii Graham Toranmal plateau, Akrani.

Name Locality MOLLUGINACEAE Glinus lotoidea Linn Yawal range. =Mollugo hirta Thub. Trianthema portulacastrum Linn. Satpuda. UMBELLIFERAE Centella asiatica (Linn.) Urb. Raver range on the sandy banks Arunavati river. RUBIACEAE Adina cordifolia (Roxb.) Hook, Taloda range, Shirpur range, Chopda range, Boradi, Sindva pass. Mitragyna parvifolia Toranmal plateau, Taloda range, (Roxb.) Korth. Shahada range, Shirpur range, =Stephegyne parvifolia Korth. Yawal range. Oldenlandia herbacea (Linn.) Shirpur range. Roxb. =Oldenlandia heynii R. Br. Mussaenda glabrata (Hook. f.) Khandesh, Taloda range, Hutchin. Shahada range, Akrani. =Mussaenda frondosa Linn. P. P. Gardenia resinifera Roth. Chopda range. =Gardenia lucida Roxb. Gardenia gummifera Lihn. .. Khandesh, Taloda range, Shahada range, Akrani-on the slopes of the 1st range from Forest Dak Bungalow, Gardenia turgida Roxb. .. Pal, Shirpur range, Chopda range, Langada-Amba. Meyna laxiflora Roxb. Toranmal plateau, Shahada range. = Vangueria spinosa Roxb. Shirpur range, Boradi, Sindva pass. Khandesh, Satpudas, Raver range, Ixora arborea Roxb. Ex. Sm. =Ixora parviflora Vahl. non Lamk. Shirpur range, Chopda range, Taloda range, Shahada range, Boradi. Ixora coccinea Linn. Pal jungles, Raver range, Yawal range. Anthocephalus cadamba Mog. Satpudas. ٠. Diplospora apiocarpa Hook. Chopda range. Knoxia corymbosa Willd. Raver range. . . Morinda citrifolia Linn. ... Khandesh, Raver range. Morinda tinctoria Roxb. Khandesh, Raver range. . . Borreria stricta (L.) Schum. Satpudas. =Spermacoce stricta Linn. COMPOSITAE Vernonia cinerea (Linn.) Less. Taloda range. =Conyza cinerea Linn. ... Shahada range, Shirpur

Chopda

Akrani.

range, Yawal range,

Locality

Elephantopus scaber Linn. Ageratum conyzoides Linn. Grangea maderaspatana (Linn.) Poir. Conyza stricta Willd.	Yawal range, Akrani. Toranmal plateau, Raver range, Shirpur range, Chopda range, Yawal range, Akrani.
·	Toranmal plateau, Yawal range, Chopda range, Yawal range, Akrani.
Sphaeranthus indicus	Toranmal plateau—in cultivated fields near the lake.
Vicoa indica (Willd.) DC =Vicoa auriculata Cass.	Satpuda, Toranmal plateau on barren slopes.
Caesulia axillaris Roxb	Chopda range, Yawal range, Raver range, fallow areas after first showers of rain.
Lagasca mollis Cav. Eclipta prostrata (Linn.) Linn. = Eclipta alba (Linn.) Hassk.	Raver range, Langda-Amba. Toranmal plateau, Akrani.
=Eclipta erecta Linn.	
=Verbesina prostrata Linn. Tridax procumbens Linn.	Raver range, near Pal, Forest Dak
Emilia sonchifolia (Linn.) DC. =Cochalia sonchifolia Linn.	Bungalow. Pal, Raver range, Shirpur range, Chopda range, Yawal range,
g to a successive Trimes	Akrani.
Sonchus arvensis Linn Volutarella ramosa (Roxb.) Santapau.	Raver range.
=Volutarella divaricata Benth and Hook, f.	Raver range.
Glossocardia bosvallea (Linn. f.)	Satpudas.
Echinops echinatus DC	Toranmal plateau, Yawal range, Shirpur range, very common in felled forest areas on stony ledges.
MYRSINACEAE	
Embelia robusta Roxb	Akrani.
SAPOTACEAE	
Madhuca indica Gmel	Taloda range, Shahada range. Akrani.
	Akrani—near the Forest Depot.
Mimusops elengi Linn Manilkara hexandra (Roxb.) Dub. = Mimusops hexandra Roxb.	Taloda range, Shahada range,
Achras sapota Linn BENACEAE	Akrani.
Diospyros chloroxylon Roxb	Toranmal plateau, Shirpur range, Shahada range, Chopda range, Yawal range, Sindva pass.
OLEACEAE	
Jasminum multiflorum (Burm. f.) Andr.	Pal Forest,
=Jasminum pubescens (Retz.) Willd.	

Name	Locality
Nyctanthes arbor-tristis Linn	Appears to be wild in Akrani, Toranmal plateau, Taloda range, Shahada range Sindya pass
Olax scandens Roxb	Shahada range, Sindva pass. Khandesh, Akrani in the ravines, Toranmal plateau.
Schrebera swietenioides Roxb	Raver range, Chopda range, Akrani, Toranmal plateau, Shahada range, Chopda range.
APOCYNACEAE	
Carissa congesta Wight = Carissa carandas Graham non Linn.	Toranmal plateau, Yawal range, Akrani.
Alstonia scholaris (Linn.) R. Br. Holarrhena antidysenterica (Linn.) Wali.	Raver range, Pal village. Chopda range.
Wrightia tinctoria R. Br	Khandesh, Toranmal plateau, Akrani.
Nerium indicum Mill	Chopda range-Forest depot.
=Nerium odorum Soland. Ichnocarpus frutescens R. Br	Catnudas
ichnocarpus frutescens R. Bi	Satpudas.
ASCLEPIADACEAE	A 75 5
=Periploca indica Linn.	Raver range, Shirpur range, Chopda range.
Cryptolepis buchanani Roem. and Schult.	Khandesh, Shirpur ranges, Boradi Sindya pass Akrani
Schult. Cryptostegia grandiflora Br	On the banks of Arunavati, Akrani.
Calotropis gigantea (Linn.) R. Br.	Raver range, Sindva pass, Boradi.
Sarcostemma intermedium DC	Khandesh Forest. Akrani.
=Dregia volubilis Benth. ex Hk. f.	
GENTIANACEAE	
Contaurium roxburghii (G. Don)	Raver range, near Forest village
Druce. · Conscora diffusa R. Br	tank of Chandasaili. Shirpur range, Sindva pass.
=Canscora lawii Wight Conscora decurrens Dalz	On the banks of Aner river,
Enicostemma verticillatum (Linn.)	Taloda range.
Engl.	Satpudas.
=Enicostemma littorale Blume. Hoppea dichotoma Willd	Pal jungles.
BORAGINACEAE	
Cordia macleodii Hook	Khandesh, Shahada range, Shirpur range, Sindva pass.
Cordia dichotoma	Taloda range, Shahada range.
Cordia wallichii G. Don	Khandesh, Akrani.
Heliotropium indicum Linn	Verv common in waste heaps in forest villages—Chopda range, Yawal range.

Locality

Trichodesma amplexicaulae Roth... =Trichodesma zeylanicum R. Br.

Raver range. the banks of Arunavati On river,

CONVOLVULACEAE

Cuscuta reflexa Roxb. Evolvulus alsinoides Linn.

Raver range. In dry puddles, Yawal range. . .

Convolvulus arvensis Linn. Convolvulus pluricaulis Chois

Taloda range. Taloda range. . .

Ipomoea campanulata Linn.

Khandesh, Taloda range, Shahada range, Shirpur range. In Betul Satpudas.

Ipomoea reniformis Chois. Rivea hypocrateriformis Chois. ...

Pal jungles, Raver range. Akrani.

SOLANACEAE

Solanum nigrum Linn. Solanum xanthocarpum Schrad Raver range, and Wendl.

Physalis minima Linn. Raver Nicotiana tabacum Linn. ...

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Near Raver Rly. station. Yawal range,

range (Fallow area) Akrani.

SCROPHULARIACEAE

Scrophularia chinensis Linn. ... ==Celsia coromandeliana Vahl. Bacopa monnieri (Linn.) Pennell. =Herpestis monnicra Benth. Lindenbergia indica (Linn.) O. ...

=Lindenbergia polvantha Royle ex

On the dry banks of river Suki, Shahada range. Raver range.

Khandesh, Raver range.

BIGNONIACEAE

Ktze.

Benth.

Dolichandrone falcata Seem. . .

Khandesh, Satpuda, Taloda range. on Toranmal plateau-in the ravines, Akrani-on steep ledges. Khandesh, Taloda range.

Heterophragma quadriloculare... (Roxb.) K. Schum.

Stereospermum xylocarpum Wight.

Khandesh, Satpuda, Taloda range. Dang jungles, Taloda.

Radermachera xylocarpa (Roxb.) K. Schum.

=Stereospermum xylocarpum

Benth. and Hk. f. Tecoma stans (Linn.) Hbk.

Tecomella undulata (Smith) Seem. Millingtonia hortensis Linn.

Khandesh, Taloda range, Shahada

range, Raver range. Khandesh, Taloda, Shahada range. Taloda range-near the Forest Dak bungalow, Shahada range, Shirpur. Chopda, Yawal,

PEDALIACEAE

Martynia annua Linn. *≡Martynia diandra* Glox. On pathways, in Chopda range.

Akrani.

A-127-22-A.

Name Locality ACANTHACEAE Blepharis asperrima Ness An undergrowth in the forest, Taloda, Shirpur range. Asteracantha longifolia (Linn.)... In ditches near the forest village Ness. of Ranipur. =Hygrophila spinosa T. Anders. Taloda range. Dipteracanthus prostratus (Poir.). Shirpur range, Sindva pass, Boradi prostrata Poir. var. ⇒Ruellia dejecta Clarke. Hemigraphis dura T. Anders Shirpur range, Sindva pass. Petalidium barlerioides (Roth.) Ness. Satpudas. Carvia callosa (Ness) Bremek. . . Khandesh, an undergrowth in =Strobilanthes callosus Nees. forests where trees are not too dense, Pal, Toranmal plateau. Taloda range, Shirpur range, Chopda range. Haplanthus neilgherryensis Wight Pal jungles. Barleria prionitis Linn. ... Taloda range, Shahada range, Shirpur range, Sindva pass, Boradi. Lepidagathis trinervia Wall. Pal, Toranmal plateau. Rungia elegans Dalz. and Gibs. ... Satpudas. Ecolium voiride (Forsk.) Alston Khandesh, Toranmal plateau. var. laetevirens (Clarke) Raizada Justicia diffusa Willd. Satpudas. Justicia quinquengularis Koehne ... Satpudas. Adhatoda vasica Nees Khandesh, Toranmal plateau. Taloda range, Shahada range, Raver range. Peristrophe bicalyculata (Retz.) Taloda range. Nees. Eranthemun nervosus (Vahl.) R. Br. Satpudas. Daedalacanthus roseus T. Anders Khandesh jungles. Tubiflora acaulis O. Kuntze Sindva pass. VERBNACEAE Linn. var. Lantana camara Toranmal plateau, Taloda range. aculeata Linn. Yawal range, Raver range, Lantana indica Roxb. Pal jungles. Phyla nodiflora (Linn.) Greene, Near Kaladoha, on the way to =Lippia nodiflora A. Rich. Toranmal plateau. Gmelina arborea Roxb. ... Khandesh, Taloda range. Vitex negundo Linn. At the foot of Yawal range =Vitex bicolor Willd. Khandesh, Taloda range. Clerodendrum phlomidia Linn. f. LABIATAE Ocimum sanctum Linn. Chopda range, Raver range, Pal Dak bungalow. Ocimum americanum Linn. Akrani—Forest Dak bungalow. =Ocimum canum Sims. Plectranthus mollis (Ait.) Spreng. On the banks of Arunavati.

Hill slopes.

Toranmal plateau,—on the banks

of the larger lake, Akrani—common on the slopes.

Pogostemon paniculatus Benth. ...

Colebrookea oppositifolia Smith.

Locality Name

Satpudas, Shahada range, Raver Leucas aspera Spreng. range, very common on the pathways on the forests.

Satpudas. Leucas mollissima Wall. ... Satpudas Orthosiphon pallidus Royle Lavendula bipinnata O. Kuntze Raver range.

== Lavendula burmanni Benth.

NYCTAGINACEAE

Taloda, Shahada range, common Boerhaavia diffusa Linn. . . in lower parts of the range.

AMARANTHACEAE

Toranmai plateau. Taloda Celosia argentea Linn. range, very common after rains

on slopes.

.. Ranipur-on slopes behind the Amaranthus spinosus Linn.

forest village.

At the foot of Yawal range. Amaranthus blitum Linn.

var. oleracea Hook. f.

=Amaranthus paniculatus Linn... Toranmal plateau, Taloda near

hot water spring of Unabdev Sunabdev.

Satpudas. Aerva fanata (Linn.) Juss.

plateau, Achyranthes aspera Linn. Toranmal Taloda.

Shahada range.

var. porphyristacya Hook. f. Alternanthera sessilis (Linn.) R. Br. In puddles near Forest village, = Alternanthera triandra Lamk. Taloda range, Shirpur range., Dhule, Akrani.

Digera muricata (Linn.) Mart. = Digera arvensis Forsk.

... Dhule, Pal jungles. Nothosaerva brachiata Wight ... Khandesh jungles. Psilostachys sericea Wight

POLYGONACEAE

सत्यमेव जयत Pal on the banks of Arunavati Polygonum plebejum R. Br.

river.

PIPERACEAE

.. Akrani. Piper nigrum Linn.

LORANTHACEAE

Dendropthoe falcata (Linn. f.) Satpudas.

=Loranthus falcatus Linn. f.

SANTALACEAE

.. Taloda range, Shahada range. Santalum album Linn. ..

EUPHORBIACEAE

Akrani on the slopes, Toranmal Euphorbia neriifolia Linn. plateau, on rocky ledges, as we =Euphorbia ligularia Roxb.

pass through bridle tracks from Dara to Mandvi. Toranmal plateau, on steep rocky ledges.

near Sitaki-Nahani.

Euphorbia microphylla Lamk. In stream beds in ravines, Taloda. Shahada range.

Name		Locality
Poinsettia pulcherrima R. Grai Euphorbia purviflora Linn. Euphorbia hypercifolia Linn. Euphorbia hypercifolia		Chopda range, near forest depot. Raver. Sindva, Raver range. Boradi.
Euphorout hypereijona parviflora prain. Euphorbia hirta Linn. Euphorbia thymifolia Linn.	var.	Satpuda ranges. Satpuda, Akrani, Shirpur range,
Euphorbia splendens Boj. ex H	ook.	Sindva pass, Boradi. Akrani.
Acalypha ciliata Forsk		Satpudas
Acalypha malabarica Muell At	g.	Satpudas.
Acalypha indica	• •	Taloda range, Shahada range Sindva pass, Boradi.
Chrozophora plicata A. Juss Mallotus philippinesis (Lamk.) Muell. Arg.	••	Common in Satpuda. Toranmal plateau, Akrani, in the ravines.
Tragia involucrata Linn.		Raver range, at the foot of the hills, Akrani.
Ricinus communis Linn. Fluggea erosa Baill		Toranmal plateau, Taloda range, Yawal range, 3rd range, cast of forest dak bungalow.
Securinega virrosa Pax and Ho	ſſm.	Akrani.
MORACEAE		
Ficus bengalensis Linn.	M	Toranmal plateau, near the larger lake, besides Shiva's temple.
Ficus religiosa Linn		Toranmal plateau, near the larger lake besides Shiva's temple.
Ficus lucescens Blume Ficus infectoria Roxb.	His	Unabdev-Sunabdev hot springs, Taloda range.
Ficus hispida Linn: f.	यापेन	जयते
= Ficus oppositifolia Willd. Ficus glomerata Roxb. =Covellia glomerata Moq.	4.14	Forest Depot, Yawal range.
Ficus elastica Roxb.	••	Taloda range, near forest dak bungalow, Chikhaldara plateau.
Ficus tsiela Roxb		Yawal range near forest depot.
Morus alba Linn	••	Chikhaldara plateau, near forest dak bungalow.
CANABINACEAE		
Cannabis sativa Linn	• •	Akrani.
ORCHIDACEAE		
Habenaria marginata Colebr. Vanda roxburghii R. Br.	••	In Betul, Satpudas.
ZINGIBERACEAE		To be found to a first of

In ravines along bridle paths from Nagjhiri to Toranmal plateau, Akrani. Kaempfera scaposa (Nimmo) Benth. Hedychium scaposum Nimmo. Curcuma montana Roxb.

.. Moist regions of Satpudas.

Raver

Name.

Locality

MUSACEAE

Ensete superbum (Roxb.) Cheesman.

- -- Musa superba Roxb.
- -Musa textilis Graham.

On rocky ledges along bridle tracts from Nagjhiri to Toran-mal plateau, also on rocky ledge near Sita-ki-Nahani valley.

HYPOXYDACEAE

Curculigo orchioides Gaertn.

Common under shade of trees, Taloda range, Shahada range, Chopda range.

In Betul, Satpudas.

Forest Dak Bungalow,

AMARYLLIDACEAE

Crinum ensifolium Roxb.

Pancratium triflorum Roxb.

range.

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٠. .

Pancratium parvum Dalz, ... Toranmal plateau.

AGAVACEAE

Agave vera-cruz Mill.

.. Chopda range, in ledges around Agro-Silviculture Farm of Forest Depot.

DIOSCOREACEAE

Dioscorea bulbifera Linn. Dioscorea oppositifolia Linn. . Taloda range, Shahada range.

. Taloda, Shahada range, Akrani range.

LILIACEAE

Asparagus racemosus Willd.

.. Toranmal plateau, Taloda Baker range, Shahada range, Chopda-Yawal range.

Gloriosa superba L.

Toranmal, Taloda range, Shahada, Shirpur, Chopda range, Akrani.

SMILACEAE

Smilax zeylanica Linn.
= Smilax macrophylla Roxb.

Shirpur range, Sindva pass, Boradi.

COMMELINACEAE

Commelina bengalensis Linn, Murdannia nudiflora (Linn.) Brennan.

= Commelina nudiflora Linn.

Toranmal plateau, Akrani.

. Taloda range, Shahada, Raver range, Akrani.

CYPERACEAE

Cyperus compressus Linn.
Cyperus difformis Linn.

Cyperus rotundus Linn. ... Cyperus triceps (Rottb.) Endl. ...

--- Kyllinga triceps Rottb. Cyperus michelianus (Linn.) Link. --- Cyperus pygmaeus Rotto.

= Juncellus michelianus Blatt. and Macann.

Cyperus alopecuroides Rottb.

Raver, Langada-Amba, Akrani.

Toranmal plateau, near the smaller lake.

Pal, on the banks of Aner river.
 Toranmal plateau, Akrani-Raver range.

Taloda range, Toranmal plateau near smaller lake.

.. Near Waghur river, Khandesh on the banks of Aner river, Taloda range.

Locality

Cyperus sanguinolentus Vahl = Pycreus sanguinolentus Nees. Cyperus malabaricus (Clarke)

Cooke.

=Pycreus malabaricus Clarke.

Cyperus tuberosus Rotth.

Cyperus pulcherrimus Willd.

Cyperus haspans Linn. ... Cyperus arenarius Retz.

Fimbristylis dichotoma Vahl. Fimbristylis digitata Boeck

Fimbristylis quinqueangularis

Kunth.:

Eleocharis atropurpurea Kunth ...

Toranmal plateau, Akrani.

Toranmal plateau.

Satpudas.

Akrani, Khandesh,

Akrani.

Shirpur range, Sindva pass. Pal, near the stream bed, Akrani.

Raver range.

Pal range near the stream bed.

Toranmal plateau.

GRAMINEAE

Apluda aristata Linn.

Apluda varia Hack.

≔Apluda mutica Linn. Aristida adscensionis Linn.

Aristida mutabilis Trin. Rupr. ... Arthraxon quartinianus Nash

= Alectoridia quartinianus A. Rich.

- Arthraxon ciliaris Beauv. Arundinella pumila (Hochst.) Steud.

= Arundinella tenella Nees and Wight.

Amphilophis odorata A. Camus ... Dichanthium annulatum (Forsk.) Stapf.

Andropogon contortus (L.) Roem. and Schult.

Andropogon foveolatus Delile Sorghum halepense Pers. ...

= Andropogon halepensis Brot. Veteveria zizanioides Linn. Nash. ---Andropogon odoratus Auct. ex Steud.

Andropogon pumilus Roxb.

Andropogon woodrowii Hook. Bambusa arundinacea (Retz)

Willd. Bothriochloa compressus (Hook, f.)

Benrard.

= Amphilophis compressa Blatter and Mcann.

Brachiaria eruciformis (Sibth and

Smith) Griseb. ⇒ Panicum eruciformie Smith.

= Panicum isachne Roth.

Satpuda range.

Taloda range, Toranmal plateau. Taloda range, Toranmal plateau. Raver hills, Chopda range.

Khandesh.

Raver range, Chopda hills, on the banks of Arunavati river, Taloda range.

Toranmal plateau, Akrani. Satpuda ranges.

Khandesh, Satpudas, Toranmal plateau Taloda range, Shahada range, Shirpur, Chopda range.

Khandesh Satpudas. Toranmal plateau, Taloda,

Akrani range. Chopda range.

Chopda, Yawal range.

Khandesh ranges.

Satpudas in Betul and Khandesh.

Ranipur.

Toranmal plateau. Taloda. Shahada range, Shirpur.

Sibth Akrani.

Locality

Toranmal plateau, Taloda range. Brachtaria ramosa (Linn.) Stapf. = Panicum ramosum Linn.Akrani, Sindva pass. Capillipedium assimile A. Camus. Khandesh, Akrani, Sindva pass. Capillipedium hugelii Blatter and McCann. Akrani range, Chopda hills, Yawal Chrysopogon montanus Trinius ... range, Raver range. = Andropogon monticola Schult. Coix lachryma-Jobi Linn. Very large and common in all Cymbopogon martini (Roxb.) ranges, Taloda range, Shahada Watson. range, Shirpur range, Akrani, = Andropogon martini Roxb. Raver range. Toranmal plateau, Taloda range, Cynadon dactylon Linn. Pers. Shahada, Yawal, Raver ranges, Akranı. Taloda, Akrani. Cenchrus biflorus Roxb. Toranmal plateau, Akrani. Chloris incompleta Roth ... Raver, Akrani. Chloris tenella Kon. Akrani. Chloris virgata Sw. Akrani. Chloris barbata Sw. Dactyloctenium aegyptiacum Willd. Pal. = Eleusine aegyptiaca Desv. f. Dichanthium caricosum A. Camus Raver range, Yawal. Toranmal plateau, Taloda, Dichanthium annulatum (Forsk.) Akrani. =Andropogon annulatum Forsk. Shirpur range. Digitaria adscandens (H. B. K.) Henrard. *Digitaria marginata* Link. var. fimbriata Stapf. *---Paspalum sanguinale* var. ciliare H. and comutalum Hook f. Shirpur range Digitaria pedicellaris Prain Shirpur range Digitaria sanguinale Scop Dinebra retroflexa Panzar Pal, Raver Banks of Tapi river, Tripogon bromoides Roth range, on the banks of Aner river Khandesh, Taloda, Yawal range Dendrocalamus strictus Nees Echinochloa colona Link. Khandesh in Sahada range. Eleusine indica (Linn.) Gartner ... Toranmal plateau, Akrani. Chopda range, Yawal range Eleusine flagellifera Nees Eragrostis cilliaris Link. Toranmal plateau, Akrani. Eragrostis tenella Beauv. var Akrani. plumosa Stapf. Eragrostis viscosa Trin. ... Toranmal plateau, Taloda range. Shahada, Yawal range.: Shahada, Yawal range.: Eragrostis cilianensis Link. Eragrostis minor Host. Eragrostis ciliata Nees Sindva Pass. Eragrostis coromandelina Trin. Satpudas. Eragrostis pilosa (Linn.) Beauv. Satpudas. =Poa pilosa Linn. Eulalia trispicata (Schult) Henrard Toranmal plateau, Akrani. =Eulalia argentea Brongn. Eremopogon foveolatus Stapf. Akrani.

Name	Locality
Garcilea royleana Hook. f	Taloda, Yawal range.
Heteropogon contortus Rogem and Schult.	
Isachne globosa (Thunb.) O. Kuntze.	On the banks of Arunavati liver, Raver range
Ischaemum aristatum Linn	Shahada range, Yawal range
Ischaemum pilosum Hack Ischaemum semisegittatum Roxb.	Shahada range, Yawal range. Shahada range, Yawal range.
Ischaemum laxum R. Br	Akrani.
Ischaemum spathiflorum Hook. f.	Akrani.
Iseilema anthephoroides Hack	Shirpur range, Yawal range.
Iseilema wightii Anders.	On the slopes along bridle tracts from Nagjhiri to Toranmal plateau.
Lophopogon tridentatus Hack	Akrani.
Nazia racemosa Kuntze	Akrani.
Oplismenus compositus P. Beauv.	Rayer range.
Oplismenus burmanwoii (Retz.) Beauv.	Raver range.
Panicum crusgalli Linn	Satpudas.
Panicum flavidum Retz	Satpudas.
Panicum isachne Roth	Satpudas.
Panicum javanicum Poir	Satpudas.
Paspalidium geminatum Stapf	Taloda.
Paspalum pedicellare Trin. ex	Satpudas.
Steud.	
Pennisetum setosum Rich	Taloda range.
Pennisetum ciliare Link	Taloda range.
Perotis latifolia Ait.	Sindva pass, Shirpur near Tapi
=P. indica.	river bank.
Phragmites maxima Blatter and McCann.	Toranmal plateau.
Polytoca barbata stapf	Toranmal plateau.
Sehima spathiflorum Blatter and	Akrani.
McCann.	Ct. inner and a co
Sehima nervosum Stapf	Shirpur range.
Setaria glauca Beauv	Akrani.
Setaria intermedia Roem. and Schult.	Taloda, Shirpur range.
Sorghum halepense Pers	Taloda, Shirpur range.
Sorghum purpureo-sericeum Aschers and Schweinf.	Yawal range, Raver.
Spodiopogon olbidus Benth	Yawal range.
Sporobolus diander (Retz.) Beauv.	Satpudas.
Sporobolus coromandelianus Link.	Akrani.
Saccharum spontaneum Linn	Satpudas.
Themeda triandra Forsk	Toranmal plateau, Taloda range,
	Shirpur, Yawa!, Akrani.
Themeda quadrivealvis O. Kuntz	Toranmal plateau.
Themeda cymbaria Hack	Taloda range.
Tripogon capillatus Jaub. and Spach.	Akrani.
Tripogon jacquemontii Stapf	Yawal range.
Thysanolaena agrostis Nees	Akrani.
Thysanolaena procera Mey	Akrani.
Urochloa reptans Stapf	Toranmal plateau.
Urochtoa setigera Stapf:	Taloda range, Akrani.

5. CHEMICAL COMPOSITION OF SOME SOILS IN KHANDESH

1 3 4 5 6 Tectona Tectona Hardwickia Acacia Acacia Zizvohus. Association grandis grandis hinata, catechu arabica rugosa Terminalia Phillanthus Boswellia Acacia tomentosa serrata catechu. emblica

pH This varies from 4·0—4·6 in most of the Associations except in 6 where *Phyllanthus emblica* it is 6.00.

CaCO₂ in log. This shows great variation from 0.002—007, 0.15 in Boswellia of air dry soil. Tectona association.

Exchangeable: This varies from 4.11—6.12 Phy. (6) association 3.72. cations Cam.e. in

Organic matter This varies much from 1.20 in Acacia to 3-81 in Tectona, Boswelia serrata least organic matter is present. Anogen-Balanite soils

Total P₂O₅ Varies from 0.043 to 0.006.

1000 gm. of soil.

Silicon
Alumina ratio varies from 2.5 in Tectona, Boswelia association soil to 2.96 in Zizyphus rugosa association soil
It is lowest 1.92 in Hardwickia, Acacia catechu association soil.
In some places soils are strongly alkaline.

6. GENERAL OBSERVATIONS ON FLORA OF KHANDESH

Khandesh is separated from the Western Maharashtra and also from Vidarbha. It is treated by Hooker and Thomson (1853) as a distinct sub-province botanically. It lies in the lower part of the Tapi valley and is separated from Western Maharashtra by the valley of Godavari which mainly flows through the districts of Nasik, Ahmednagar, Aurangabad, Parbhani and Nanded. Tapi arises at Multai in Madhya Pradesh and flowing westwards, joins the Arabian sea near Kim, near Surat. The upper part of its valley is mountainous in Maharashtra. Once it enters the Gujarat plains it flows slowly through the plains of South Gujarat down to Ukai where a new high level dam is constructed. Ukai is the last mountainous terrain through which it flows.

The other river which flows through Khandesh is Narmada, also going to Arabian sea westwards. But it has a very small part of its basin in Maharashtra, so it does not affect much. We have already described how Khandesh is climatically different from the rest of the table-land of Maharashtra. It is situated between various parallel ranges of Satpudas which are an extension of the spurs of the Sahyadris and lie in continuation with the trends of Vindhyas. The land is mostly flat, plain, the soils are deep, rich black cotton soils: some are alluvial. The whole of Khandesh stands at an elevation of 710' (216 mtrs.) and its hilly terrain rises a little higher, about 300' (91 mtrs.) above it. On both sides, the slopes of hills of Ajantha and on the other side of the hills of Satpudas extend and they are flat-topped and plain. The rains though not heavy are well spread and continue long. The sub-soil water table is deep, the humidity lasts throughout rainy season. It is extremely congenial for the growth and production of cotton which is produced abundantly. The districts of Jalgaon and Dhule have nearly the same climate, but as we go east towards Jalgaon, it becomes extremely hot in summer months.

The flora is mostly of the deciduous type in the hills of Satpudas and is not much different from that in other parts of Maharashtra. In many places in the plains there is dry scrub jungle, or a dry thorn Savannah, but on the hilly slopes of mountains, forests are wooded consisting of Tectona grandis, Terminalia arjuna, T. tomentosa, Adina cardifoha, Anogeissus latifolia in different associations of Tectona and Terminalia. The rest of it is a thorn Savannah or scrub jungle having Zizyphus rugosa, Acacia Sp., Phyllanthus emblica, Balanites roxburghii, Flacourtia ramontchi, Bridelia retusa etc. The growth of Tectona grandis and other tree species here is rather poor. Small trees of Boswellia serrata, Grewia tiliaefobia Capparis grandis, Capparis divaricata, Rhus mysorensis, Gymnosporia montana are abundant. This is in no way different than the flora of dry low hills of Pathardi, Shevgaon, and Ahmednagar talukas of Ahmednagar district.

In many places on the slopes of the hills in Dhule district, we find forests of *Hardwickia binata* and *Anogeissus latifolia*.

The list of species shows most plants of Khandesh especially in Satpuda areas and adjoining territory. It will be seen that there are very few or none humid species but are mostly dry deciduous or scrubby. This is because the climate suffers from extremes. The temperature, humidity and rainfall at Dhule, Chalisgaon, Jalgaon and Bhusawal clearly show it. The black cotton soils beyond Tapi are not very deep. They are often calcareous (See analysis of soil at different places).

7. SOME SPECIAL FEATURES OF KHANDESH FLORA

Satpuda Mountains Surroundings, and their Flora:

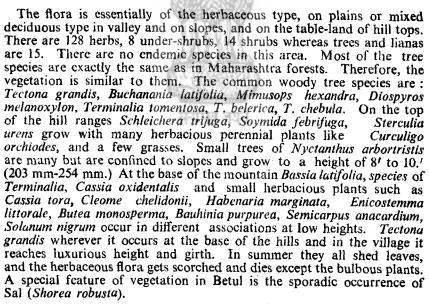
Satpuda mountains form a characteristic feature of Khandesh. They extend through Madhya Pradesh from Betul to Nimar districts, Gawilgarh and Burhanpur. A list of plants in Satpudas in Khandesh is given (pp. 329-346) and those in Betul district as given by Moghe (1921) and other is shown on pp. 348-353. The flora of entire Satpudas is not known, 'Satpuda hypothesis' of Flora is important for the interpretation of the migration of species from North India and Estern Himalayas, Assam, to Peninsular India. A comparison of the two parts of Satpudas will be interesting. In Maval region of Western Maharashtra, the flora between two Mavals is separated by hill ranges, and it gets isolated from each other and becomes distinctive in character for each Maval. Similarly flora between different ranges of Satpudas in Khandesh also develops features of its own in each range. It would be difficult to compare the flora of all the hill ranges of Satpudas, but as an example, one may compare the flora of Yawal or Shahada ranges forming midranges of Satpudas with the extreme end ranges in Raver and Akrani bordering on the territory of Madhya Pradesh.

8. BETUL SATPUDAS

The general height of Khandesh above the plain is 700'-800' (213-243 Mtrs.) Betul in Madhya Pradesh is largely a hilly area having 2173'-2189' (652-657 Mtrs.) altitude. The average rainfall is 40-"28" (992-711 mm.) The number of rainy days are 67. The temperature average varies from 61.5°F in the morning at 8 am. The maximum in the morning goes upto 86°F in May, and to 91°F in June. At 4 p.m. in May it is 102°F, but it comes down soon as the rains begin and falls further in the month of July. There is a slight secondary rise in temperature in the month of October.

The terrain of Satpudas for the greater part in Betul is an undulating table land with stony ridges. But the valley of Machna in Betul on the southern side is a level tract. In valleys on the northern side, soil is alluvial but shallow. In the hilly regions soils are gravel or sandy even on hill tops. Naturally the water gets down the slopes in vallyes very quickly. It supports a thick forest of moist deciduous type. The rainfall annual average is 43''-48'' (992-1119 mm.). Humidity in monsoons is pretty high. The non-living soil cover is formed by dry leaves of the forest trees forming 4'' or 6'' (101 mm. or 152 mm.) thick cover. Naturally one expects a good vegetation under these conditions and so it is. There are 226 known species, spread over 176 genera belonging to 55 families so far recorded. The ratio of monocots to dicots is 1: 4.3. The principal large families in this region are—

Leguminosae
Compositae
Rubiaceae
Asclepiadaceae
Malvaceae
Acanthaceae
Amarantaceae
Combretaceae
Euphorbiaceae.



A perusal of the list of plants in Betul Satpudas suggests mixture of dry and most deciduous species. In dry hill tracts Cochlospermum gossypium, Butea monosperma, Sterculia urens, species of Capparis and Flacourtia occur. They suggest drier conditions. The abundance of Acanthaceae Labiatae especially of the genus Leucas, palms such as Phoenix sylvestris and Phoenix acaulis, Bombusa arundinacea and Dendrocalamus strictus are commonly seen as in Chhota Nagpur, Bengal plains and Maharashtra. There is however a difference. In any place in Betul Tectona grandis and Terminalia Spp. or Bassia latifolia grow in

large numbers to the extent of 50 per cent of vegetation in the forests. In some places *Tectona grandis* is mixed with *Boswellia serrata* and *Terminalia tomentosa*. Grass grows on open table-land on hill tops, but it dries up in summer. It is very hot and many species resort to various methods of perennation with the help of their underground parts.

LIST OF PLANTS IN BETUL SATPUDAS

(Enumerated by Moghe, 1921)

सत्यमव जयत

Name

Papaveraceae:

Argemone mexicana Linn.

Capparideae:

Cieome simplicifolia Hook. f.

C. chelidonii Linn.

C. viscosa Linn.

Gynandropsis pentaphylla DC.

(= G. gynandra). Capparis horrida Linn.

Violaceae:

Ionidium suffruticosum Ging.

Bixineae:

Cochlospermum gossypium DC. Flacourtia romontchi L.' Herit.

Portulacaceae:

Portulaca oleracea Linn. Portulaca quadrifida Linn.

Malvaceae:

Sida humilis Willd.
Sida spinosa Linn.
Abutilon indicum G. Don.
A. graveolens W and A.
Urena sinuata Linn.
Bombax malabaricum DC.
Ceiba hexandra Gaitern.

Sterculiaceae:

Sterculia urens Roxb.

Tiliaceae:

Grewia hirsuta Vahl.

Geraniaceae:

Biophytum sensitivum DC.

Rutaceae:

Feronia elephantum Correns. Aegle marmelos Correvs.

Simarubeae:

Ailanthus excelsa Roxb.

Balanites roxburghii Planch.

Bursera ceae:

Boswellia serrata Roxb.
Balsamodendron mukul Hook.

Meliaceae:

Melia azadirach Linn. M. azadirachta Linn. Soymida febrifuga Adr. Juss.

Celastrineae:

Elaeodendron glacum Pers.

Rhamneae:

Zizyphus jujuba Lamk. Zizyphus oenoplia Mill.

Sapindaceae:

Schleichera trijuga Willd.

Anacardiaceae:

Buchnannia latifolia Roxb. Semecarpus anacardium Linn.

Leguminoseae:

Heylandia latebrosa DC.
Crotolaria seriacea Retz.
Indigofera linifolia Retz.
I. enneaphylla Linn.
I. trita Linn.
I. cordifolia Heyne.
Psoralea corylifolia Linn.
Tephrosia purpurea Pers.
Phaseolus trilohus Ait.

Phaseolus trilobus Ait. Alysicarpus rugosus DC.

A. styracifolius DC.

Ougeinia dalbergioides Benth. Desmodium gangeticum DC.

Abrus precatorius Linn.

Butea frondosa Roxb. (= Butea monosperma).

यमव जयर

B. superba Roxb.

Cylista scariosa Roxb.

Rhynchosia minima DC.

Dalbergia sissoo Roxb.

D. latifolia Roxb.

Pterocarpus marsupium Roxb.

Pongamia glabra Venland.

Caesalpinia bonducella Flemming.

Caesalpinia sepiaria Roxb.

Parkinsonia aculeata Linn.

Cassia fistula Linn.

Cassia tora Linn.

C. occidentalis Linn.

C. absus Linn.

Bauhinia racemosa Lamk.

B. Vahli W. and A.

B. variegata Linn.

Mimosa hamata Willd.

Acacia arabica Willd.

A. leucophloea Willd.

A. farnesiana Willd.

A. catechu Willd.

Albizzia odoratissima Benth.

Neptunia triquetra Benth.

Combretaceae:

Terminalia belerica Roxb.

T. chebula Retz.

T. arjuna W. and A.

T. tomentosa W. and A.

Anogeissus latifolia Wall.

Myrtaceae:

Eugenia jambolana Lamk. Careya arborea Roxb.

Lythraceae:

Woodfordia floribunda Salisb. (= W. fruticosa Kurz.) Lagerstroemia parviflora Roxb

Ficoideae:

Trianthema monogyna Linn. Mollugo hirta Thumb.

Umbelliferae:

Hydrocotyle rotundifolia Roxb.

Rubiaceae:

Anthocephalus cadamba Miq.
Adina cordifolia Benth and Hook.
Knoxia corymbosa Willd.
Stephegyne parviftolia Korth.
Oldenlandia aspera DC.
Gardenia lucida Roxb.
Ixora parviftora Vahl.
Spermacoce stricta Linn.

Compasiteae:

Vernonia cinerea Nees.
Grangea maderaspatana Poir.
Conysa stricta Willd.
Caesulia axillaris Roxb.
Glossocardia linearifolia Cass.
Eclipta alba Hassk.
Vicoa auriculata Cass.
Lagasca mollis Cav.
Tridax procumbens Linn.
Emilia sanchifolia DC.
Echinops echinatus DC.
Volutarella divaricata Benth and Hook.
Launaea nudicaulis Hk.

Myrsinaceae:

Embelia robusta Roxb.

Sapotaceae:

Bassia latifolia Roxb.

Ebenaceae:

Diospyros melanoxylon Roxb.

Oleaceae:

Nyctanthes arbor-tristis Linn.

Apocynaceae:

Carissa carandus Linn. (=C. congesta Vatl) Holarrhena antidysenterica Wall. Ichnocarpus frutescens Br.

Asclepiadaceae:

Hemidesmus indicus Br.
Cryptostegia grandiflora Br.
Calotropis gigantea Br.
C. procera Br.
Dregea volubilis Benth.
Leptadenia reticulata W and A.

Gentianaceae:

Enicostemma littorale Blume, Erythria roxburghii Don. Canscora decurrens Dalz.

Boragineae:

Cordia myxa Linn. Trichodesma indicum Br. T. amplexicaula Roth.

Convolvulaceae:

Ipomoea reniformis Chois.
Convolvulus pluricaulis Chois.
Convolvulus arvensis Ling.
Evolulus alsinoides Ling.
Cuscuta reflexa Roxb.

Solanaceae:

Solanum xanthocarpum Sch. S. nigrum Linn. Datura fastuosa Linn, var. alba.

Scrophulariaeae:

Celsia coromandeliana Vahl. Herpestis monniera Benth. Striga euphrabioides Benth.

Pedaliaeae:

Martynia diandra Glax.

Acanthaceae:

Hygrophila spinosa T. Anders. Ruellia prostrata Lamk. Petalidium barlerioides Nees. Daedalacanthus roseus T. Anders.

Justicia diffusa Willd. Var. vahlii. C. B. Clarke. Var prostrata C. B. Clarke. J. quinqueangularis Roen. Rungia elegans Dalz. Peristrophe bicalyculata Nees.

Verbenaceae:

Lantana camara Linn. Tectona grandis Linn. Vitex negundo Linn. Lippia nodiflora Mich.

Labiatae:

Orthosiphon pallidus Royle.
Plectranthus incanus Linn.
Lavandula burmanni Benth.
Pogostemon paniculatus Benth,
Leucas mollissima Wall.

Nyctagineae:

Boerhaavia repens Linn.

Amarantaceae:

Celosia argentea Linn. Amarantus spinosus Linn. Aerva lanata Juss. Achyranthes aspera Linn. Digera arvensis Forsk. Alternanthera sessilis Br.

Polygonaceae:

Polygonum plebejum Br.

Loranthaceae:

Loranthus longiflorus Desr. Viscum angulatum Heyne.

Euphorbiaceae:

Euphorbia pilulifera Linn.
E. rosea Retz.
E. thymiflora Burm.
Phyllanthus emblica Linn.
Jatropha gossypifolia Linn.
Chrozophora plicata A. Juss.
Acalypha malabarica Muell.
Acalypha ciliata Forsk.
Mallotus philippinensis Muell.
Tragia involucrata Linn.

Urticaceae:

Ficus bengalensis Linn. F. hispida Linn. F. religiosa Linn. F. glomerata Roxb.

Orchidaceae:

Vanda roxburghii Br. Habenaria marginata Coleb.

Scitamineae

Curcuma montana Bak.

Amaryllideae

Curculigo orchioides Gaertn. Crinum ensifolium Roxb.

Dioscoreaceae

Dioscorea oppositifolia Linn. D. bulbifera Linn.

Liliaceae

Smilax macrophylla Roxb. Asparagus racemosus Willd. Gloriosa superba Linn.

Commelinaceae

Cyanotis axillaris Schult.

Palmeae

Phoenix acaulis Roxb. P. humilis Royle.

Cyperaceae

Kyllinga triceps Rottb. Cyperus tuberosus Rottb. Cyperus rotundus Linn.

Gramineae

A-127-23-A.

Paspalum pedicellare Trin. P. sanguinale var. P. ciliare Lamk. Panicum isachne Roth. Panicum flavidum Retz. P. crus-galli Linn. var. frument. P. colonum Linn. P. javanicum Poir. Pennisetum pedicellatum Trin, Coix lachryma-jobi Linn. Apluda varia Hack. Saccharum spontaneum Linn, Andropogon caricosuss Linn. A. annulatus Forsk. A. contortus Linn. Setaria glauca Beauv. Setaria intermedia Roem. and Sch. Chloris barbata Sw. Dinebra arabica Jacq. Pseudanthistiria hispida Hook. Soprobolus diander Beauv. Cynodon dactylon Pers. Eragrostis coromandeliana Trin. E. pilosa Beauv. Dendrocalamus strictus Nees. Bambusa arundinacea Willd.

9. VEGETATION TYPES AND IMPORTANT PLANT COMMUNITIES IN KHANDESH SATPUDAS

A profile of vegetation in Satpudas in Khandesh was studied by Forest authorities and examining transacts thereof. According to Karnik (1959) there are 6 different forest types of woody species in this region. They may be classified according to rainfall: (389—1143 mm.)

(1) Exceeding 35" to 45", Dry deciduous forests representing climatic climax.

Tectona grandis association (Pole type).

Tectona grandis forest (Timber type).

Edaphic climax association is formed by Anjan or Hardwickia binata.

(2) Where rainfall is below 25" (635 mm.) there is only thorn savanah. The composition of these plant communities varies in each.

The most interesting of these are the vegetation types of Toranmal plateau on the slopes of which there is a dry deciduous forest or a sparse wood land or Savannah of Tectona grandis and a scrub on the cliffs. The secondary vegetation in the Tectona grandis forest consists of Woodfordia fruitcosa, Butea monosperma, Lantana camara, Vitex negundo and Dalbergia sisoo. In Hardwickia binata forest community on the lower ranges, the secondary vegetation consist of grasses like Andropogon pumilus, Andropogon contortus, Ischaemum segatum, and also Butea monosperma, Carvia callosa. In the poor soils Tectona grandis, Acacia catechu, Anogeissus latifolia, Holarrhena antidysenterica, Balanites roxburghii, Cassia auriculata, Echinops cephalotus and Lantana camara occur. Near Taloda, small streches of poor trees of Tectona grandis are seen, but near Yawal mixed deciduous forest consisting of Tectona grandis and Adina cordifolia occurs. Bamboos occur sparingly near Ranipur viz. Dendrocalamus strictus as brake but near Raver only grasses like Andropogon halepensis and Cymbopogon martinii are found. On eroded soil trees of Balanites and woody thatch grass Themeda triandra are common. If protected, the grass-land by stages leads to dry thorn savannah. Grasses, Mimosa hamata, Acacia leucophloea form thorn savannah of Balanites roxburghii and Flacourtia ramontchi. There are various climax plant communities. The climatic climax is illustrated by dry deciduous forests in which Tectona grandis is the main species, but the growth of it is poor. It occurs in Akrani, Taloda, Shirpur, Chopda and Yawal. The associates of it are Terminalia tomentosa, Terminalia balarica, Terminalia arjuna, Lannea grandis, Lagerstroemia parviflora. But the proportion and sub-dominance of these change at different places, as the water content of the soil in different places such as Akrani, Dhadgaon and Ranipur goes on decreasing. Naturally the size of the woody trees become small.

Their succession here is as follows:-

Tectona grandis, Eugenia dalbergioides.

Adina cordifolia, Anogeissus latifolia.

Boswellia serrta, Pterocarpus monsupium.

Finally it leads to the growth of Andropogon halpensis. Where the forests are cleared, grasses grow, and bamboo brakes develop on gradual slopes. On the banks of rivuletes formation of Hardwickia binata is

A-127-23-B.

ormed. It represents edaphic climax. They are generally found in ew definite localities on recent alluvium formed from denudation of ocks or erroded soils. It is the soil here which determines germination nd growth of *Hardwickia binata* seeds and the survival of their seedlings. It was shown by Karnik (1959) that black cotton soil when available such at Pal, it is favourable to *Hardwickia* seedlings. This soil has the ollowing characteristics.

Air content 25.2 per cent.

Water content 24.1 per cent.

Air capacity 10.5 per cent.

Water capacity 40.2 per cent.

lometimes it contains a high ratio of silica sesquioxide.

The third important plant community which is useful in providing wood, or fuel is Acacia catechu. Anogeissus latifolia is found on the fringe of Tectona grandis forest at Shirpur on east and west hill ranges. These orests lie quite adjacent to cultivated lands and are 1 to 2 miles wide. Many of them are comparatively poor and dry. Their growth being poor, he trees are stunted. Balanties roxburghii, Anogeissus latifolia, Boswellia serrata, Flacourtia ramontchi, Zizyphus oenoplia, Echinops echinatus, Dichanthium annulatun, Aphuda varia, Andropogon pumilus Indropogon contortus represent primary dry Seral Community.

Over the greater part of Khandesh near the base of Satpuda ranges, and even on some of them the denudation is very great. On the tableland plateau as at Toranmal there is Zizyphus rugosa, Phyllanthusemblica issociations forming a dry thorn scrub or a savannah. They are due to nuch neglect of area. They also represent climax type of vegetation where the percentage of moisture and organic matter is very low. Sterculia urens, Cochlospermum gossypium, Mitragyna parvifolia, Zizyphus jujuba, Zizyphus oenoplia represent the edaphic climax. Generally i stable climax is due to climate and it represents the best of vegetation. But whenever there is disturbance due to any reason, it results in secondary regetation. Which is as a rule poorer than the original vegetation. It never attains height or growth as of original vegetation, much less in deflected climax type. Its form is also different than that of the original regetation. Secondary vegetation often results in grass-land of a poor type, e. g. on the hills near Dhule and Laling. The zonation of various plant communities is chiefly determined by the moisture present in the soil and rainfall. Examples are Yawal and Chopda ranges where zonation of the vegetation is as follows:---

Altitude			Zones						
(456608 mt	r.)								
1500—2000′	• •	••	Tectona grandis, Adina cordifolia association.						
(274289 mt	r.)								
900950'	••	• •	Acacia catechu, Anogeissus latifolia association.						
(152 mtr.)									
500′			Vitex negundo.						
(26-30 mtr.))								
250100/ (30 mtr.)	• •	••	Cassia auriculata.						
Below 100'	••	••	Grass.						

Chief plant communities in Khandesh appear to flourish in the following order showing increasing xerophytism and dependence on rainfall.

Tectona grandis forest

Fuel yielding species such as Acacia catechu

Anogeistus latifolia-Dry thorn scrub species

Zizyphus rugosa, Sterculia urens-Dry forest

Thorn savannah of Hardwickia binata, Balanites roxburghii.

The existing vegetational changes are due to plant succession.

The plant succession in Satpuda is mainly of the plant communities as shown below:

- 1. Tectona grandis—Terminalia tomentosa.
- 2. Tectona grandis, Adina cordifolia, Acacia catechu,
- 3. Anogeissus latifolia, Zizyphus rugosa, Phyllanthus emblica, Balanites roxburghii, deflection.
- 4. Acacia leucophloea.
- 5. Dry Thorn Scrub—Dendrocala nus stricuts brakes and grass, Andropagon haplensis.

It may generally be said that plant climate of Khandesh particularly of Satpuda is of the Phanerophytic type. Their facies resemble the vegetation of Chikhaldara in Amravati district, Parasnath hills in Orissa and Aravalis in Rajasthan. For detailed study of these "Ecology and Forest types" and "A Preliminary survey of the Forest types of India and Burma" by Champion (1956) as revised by Champion and Seth (1968) and Mahabale and Kharadi (1946) be consulted.

By far the most interesting vegetation occurs in Khandesh on Toranmal hill range. In Satpuda the vegetation changes from range to range. Vegetation of Toranmal lake reminds one of other lakes, but is in strong contrast with the vegetation of other lakes on the hill top of Sahyadrics such as the Venna lake (Pratap Sagar) at Mahabaleshwar or Lonar lake in Buldhana district. This is not only due to its situation in a relatively dry area, but is due to its origin also. This lake on the top of Toranmal is supposed to be a crater lake of vulconic origin. Such is not the origin of the other lakes. Similarly Telangkhedi lake at Nagpur or the large lake at Umred near Nagpur lie in Deccan trap rocks or in black cotton soil derived from the trap. But the geographical situation and the vegetation surrounding each lake is different and hence the nature and constituents of their flora are different. This becomes apparent when one considers the aquatic plants found in each lake.

Take 1 as a whole the vegetation of dry deciduous forest or dry thorn scrub plant community in Khandesh is similar to the vegetation found in other parts of Maharashtra. Satpuda ranges in Khandesh constitute a continuation of the Vindhyas but of different origin. Unlike Sahyadri ranges N-S, they extend from NE to SW. They form a high way for the migration of species from Assam, Garo Hills to Sahyadries and farther down to Nilgiri and Malabar. This really is the basis of Satpuda hypothesis considered later.

10. COMPARISON OF KHANDESH AND BETUL SATPUDA FLORA AND THOSE OF OTHER REGIONS OF INDIA

The list of plants in Satpudas in Khandesh is given on page No. 327. It will be seen, that at its one end it has more woody semi-evergreen species in Betul Satpudas, whereas at the other end in Raver and Akrani, there are more of dry deciduous species. To mention a few typical ones, one may mention: Tectona grandis, Terminalia chebula, Terminalia arjuna Firmiana colorata, Ceiba pentandra, Dalbergia sisoo, Terminalia belerica, These are typical species of moist deciduous forests, but compared to the Betul Satpudas their proportion in the total plant population is not high as the rainfall in Khandesh is not so much as in Betul and the number of rainy days is less. At the same time there are many dry deciduous species in Khandesh Satpudas the same as in Marathwada or Vidarbha region e. g. Anogeissus latifolia, Cochlospermum gossypium, Balanites roxburghii, Hardwickia binata. The vegetation in different parts of Satpudas depends upon the rainfall, its distribution and range of temperature. The hill tops also are very often not thickly populated. Much of the vegetation is on the slopes. But the herbaceous species are plenty. About 50 percent of the species in Satpudas in Khandesh and in Betul are common; and though major species are the same, the growth of woody species in Betul Satpudas is better. On the other hand the herbaceous species in Betul dry up very quickly due to poor soil. Much of the woody species and vegetation are on slopes and in deep valleys in Betul. Soils also contain more humus in Betul. The terrain between two Satpuda ranges in Khandesh is plain, and in summer does not retain much moisture. The total productivity of Betul Satpudas is greater as the soils there are richer in humus and come under the influence of postmonsoon rains. The humidity temperature and rainfall in Khandesh is more conducive for the growth of cotton and other Rabi crops. Such is not the case with the hilly tract of Betul. The principal families in Khandesh Satpudas are :--

		सन्यमेव	नयते		Species
Gramineae					103
Leguminosae	÷		• •		63
Euphorbiace	ae	• •			23
Acanthaceae	٠.	• •			18
Rubiaceae	٠.	• •		• •	18
Compositae	٠.	• •		••	17
Cyperaceae		• •			16
Asclepiadace	ae	• •			10
Labiateae					. 9
Malvaceae		••	• •	••	9

In all in Khandesh there are 484 species spread over 322 genera and 80 families. Compared to this, in Betul Satpudas there are 226 species spread over 176 genera and 55 families. Of these 226 species 128 are

herbs, 8 are under-shrubs, 14 are shrubs, and 13 are lianas. They may be compared with the principal families in Betul region:—

				Genera	Species
Gramineae				17	26
Leguminosae				24	38
Acanthaceae		• •		7	8
Malvaceae		• •		4	6
Amarantaceae				6	7
Labiateae				5	6
Rubiaceae				8	8
Asclepiadaceae	••			5	5
Euphorbiaceae	••			7	11
Combretaceae	0	(Fall	1	2	5
Capparidaceae	CH.			3	5

It will be seen that the dominant families and genera and species are different in the two areas of Satpudas. They may be compared with the families (arranged in the order of abundance) in the adjoining regions of South Gujarat, Vidarbha and Western Maharashtra.

Khandesh Satpudas

Betul Satpudas

9.7. 17	100,000	1.1.1.1
Gramineae, Leguminosae	~	Gramineae, Leguminosae,
Euphorbiaceae, Acanthaceae	iler a	Compositae, Acanthaceae,
Rubiaceae, Compositae,	.14.	Malvaceae, Labiatae,
Cyperaceae, Asclepiadaceae,		Asclepiadaceae, Rubiaceae,
Labiatae, Malvaceae,		Capparidaceae, Euphorbiaceae.
G . 1. C		Canastia plain

South Gujarat

Gangetic plain

Leguminosae, Gramineae
Cyperaceae, Compositae
Euphorpiaceae, Malvaceae,
Convolvulaceae, Orchidaceae

Gramineae, Leguminosae,
Cyperaceae, Compositeae,
Scrophulariaceae, Malvaceae,

Scrophulariaceae, Malvaceae,
 Acanthaceae, Euphorbiaceae,

Convolvulaceae, Labiatae.

Madhya Pradesh

Vidarbha

Leguminosae		• •		•
Gramineae	• •	••	• •	•
Compositae				٠
Acanthaceae,	Eupho	orbiac	eac,	
Scrophularia	ceae, V	/erbe	naceae,	
Labiatae, Ma	lvacea	е	••	
Amarantacea	e.			

Leguminosae, Rubiaceae,
Acanthaceae, Malvaceae,
Verbenaceae, Apocynaceae,
Compositae, Caesalpinae

. Rhamnaceae, Anacardiaceae,

. Meliaceae.

It will be seen that the flora of this region resembles more with that of North-East region of India. The family Gramineae is prominent here as well as in the Eastern Himalayas, Aravalis and in the Deccan Flora.

The family Leguminosae occupies second place in Satpudas, in Aravalis, Malaya peninsula. Family Euphorbiaceae occupying third position in Satpudas occupies the same position in Malaya peninsula. The family Acanthaceae occupies the 4th position in Betul Satpudas, but a third position in the flora of Deccan and Malabar. The family Compositae occupies 6th position in the flora here, but it occupies a much higher position elsewhere, third in Gujarat, Aravalis and Sindh. This is to be expected as a large number of Compositae are found in the Desert of Rajputanas, Sindh and Northern Gujarat. The family Cyperaceae having 7th place here is third in Indo-ganga plain. This suggests abundance of water there. The family Asclepiadaceae 8th in Satpudas has no relation whatsoever with the flora of other regions. The family Labiatae has somewhat distant relationship with the Western Himalayan flora. The 10th family Malvaceae is poorly represented in the Satpudas.

The three dominant types of vegetation both in Betul and Khandesh. Satpudas are the same though the component species and their abundance in the two areas is different. (1) Deciduous forests, (2) Scrub or Thorn Savannah, (3) Grassland. These are also the three main types of vegetation in the rest of Maharashtra. However, it should be noted that the grasslands here are not true grasslands. The dominant forests community is dry deciduous forest comprising Tectona grandis, Terminalia tomentosa and their different association, as given already.

Deciduous Forests:

This type is seen near Taloda where the rainfall is (992—1295 mm.) 40"—52" as against this quite a different type of forest is seen in Akrani range having rainfall (482—3547 mm.) 19.73". Naturally the vegetation here is composed of different species which are drought resistant. They are Ailanthus excelsa, Diospyros melanoxylon. Clerodendron phlomides, Capparis aphylla, Bridelia retusa, Cassia fistula, Feronia elephantum. The three species Lannea grandis, Anogeissus latifolia, Lagerstroemia parviflora gradually get reduced in size due to decreased water content of the soil. Similar type of vegetation prevails in the Tectona grandis—Adina cordifolia, or Terminalia association; the edaphic climax of forest results in Hardwickia binata forest.

The final type of vegetation is formed by Acacia catechu, Anogeissus latifolia. If deflected or degraded due to grazing, fire etc., it results in scrub of Zizyphus, rugosa, Phylanthus emblica association.

On the other hand, the reverain forests representing post-climax vegetation have woody grasses, bamboos, Flacourtia ramontchia. Some times there is a mixed deciduous forest on them, e. g. near Yawal. The sequence of these is as follows: Mixed deciduous forest of Tectona grandis, Terminalia tomentosa Tectona grandis-Adina cordifolia Acacia catechu-Anogeissuslatifolia, Zizyphusrugosa, Phylanthusemblica. Balanites roxburghii, Acacia leucophloea, Hardwickia binata. The last association represents Edaphic climax. Sometimes there is deflection and the dry thorn Savannah leads to bamboo brakes formed by Dendrocalamus strictus. Further degeneration results in grassland of Andropogon halepensis due to overgrazing or fire. Then only thatch grass Themeda triandra then grows there. Very often due to erosion even this changes to Echinops echinatus facies. If protected from grazing

or fire, grassland with *Mimosa hamata* and *Acacia leucophloea* develop. It should be noted that in all these soil moisture factor is very much operative and on account of it the vegetation often gets deflected or does reach climax.

The dominant flower colour in Betul Satpudas is light yellow and also in Khandesh Satpudas. In the hot season (March to June) 37 tree species flower. In rainy season (July to October) only 8 species flower, whereas in the cold season (November to February) 26 species flower. As a rule the largest number of species, 49, flower in hot season. This is no doubt due to influence of summer temperature on them rather than any other climatic factor.

Vegetational types may be summarised as follows and their succession is also given below.

Climatic climax type-

- 1. Tectona grandis—Terminalia tomentosa association.
- 2. Adina cordifolia—Tectona grandis association,
- 3. Edaphic climax type -Hardwickia binata.
- 4. Anogeissus latifolia-Acacia catechu association.

SUCCESSION OF CHIEF FOREST COMMUNITIES IN KHANDESH

A. Dry deciduous plant community:

Tectona grandis—Terminalia tomentosa association.
Tectona grandis—Adina cordifolia association.
Acacia catechu—Anogeissus latifolia association.
Zizyphus rugosa—Phyllanthus emblica association.
Balanites roxburghii—Acacia leucophloca association.
when deflected due to cutting, fire, or neglect.

B. Dry thorn savannah:

Dendrocalamus strictus (Bamboo brakes). Andropogon halepensis—Cymbopogon martini Association. Themeda triandra—Echinops cephalotes Association.

If protected grassland with edible grasses—grows mixed with *Mimosa hamata* and *Acacia leucophloea* here and there.

सत्यमव जयस

TABLE No. VI-B-1

COMPOSITION OF TECTONA GRANDIS—TERMINALIA TOMENTOSA PLANT ASSOCIATION									
Species			F	Α	D	S			
1. Tectona grandis		••	5	4	2	2			
2. Terminalia tomentosa		••	5	4	2	1			
3. Terminalia belerica		••	3	4	2	1			
4. Terminalia arjuna		• •	4	3	2	1			
5. Anogeissus latifolia		••	3	4	3	1			

	Species			F	Α	D	s
6.	Miliusa tomentosa		• •	2	3	2	2
7.	Morinda tinctoria		••	2	3	2	1
8.	Mitragyna parvifolia		• •	2	2	2	1
9.	Ougeinia cojeinensis (?)			••	••	••	••
10.	Sterculia urens		• •	2	2	3	2
11	Garuga pinnata	٠.	• •	1	1	2	1
12.	Kydia calycina		• •	3	3	2	1
13.	Cassia fistula		• •	3	2	1	1
14.	Lagerstroemia parviflora	,		3	1	ı	2
15.	Dalbergia paniculata		• •	2	2	1	1
16.	Schrebera swietenioides		• •	2	2	1	1
17.	Dalbergia latifolia	٠.		3	3	2	1
18.	Soymida ferbrifug a			2	2	1	1
19.	Flacourtia ramontchi	. 9		2	3	2	1
20.	Strychnos potatorum			1	1	2	1
21.	Lonnea coromandelica		ANASS.	2	3	2	2
22.	Bassia latifolia	٠.	7444	2	3	2	1
23.	Melia azadirachta	٠.		3	4	3	2
24.	Boswellia serrata			3	4	3	2
25.	Gmelina arborea		TENT	2	2	1	1
26.	Diospyros melanoxylon		선덕시	2	2	1	I
27.	Dalichandrone falcata	٠.	••	2	3	2	1
28.	Careya arborea		••	2	3	2	1
29.	Ixora arborea		••	3	2	1	1
30.	Diospyros chloroxylon	٠.	••	2	1	1	1
31.	Pongamia glabra			2	1	1	. 1
32.	Ailanthus excelsa	٠.	••	2	1	3	2
33.	Bridelia retusa	• ,•	••	2	1	2	1
34.	Feronia elephantum		••	2	1	1	1
35.	Gymnosporia montana	• •	• •	2	1	1	1
36	. Albizzia procera	٠.	••	1	1	1	1
37	. Randia dumetorum	• •	••	1	1	1	1
38	. Cordia macleodii	••	••	1	1	1	1
39	. Buchanania latifolia	• •	• •	1	1	1	1
40	. Grewia tiliaefolia		••	1	1	1	1

TABLE No. VI-B,2

	COMPOSITION OF ACACL	A (Сатесни	Anogei	SSUS LATIFOLIA	Ass	OCIATION
	Species			F	A	D	S
1.	Acacia cutechu			5	5	4	2
2.	Balanites roxburghii			3	4	3	2
3.	Boswellia serrata			3	4	4	3
4.	Cochlospermum gossypi	un	ı	3	3	3	2
5.	Odina woodier			3	3	2	2
6.	Flacourtia ramontchi			3	2	2	1
7.	Zizyphus mouritiana			3	3	3	1
8.	Zizyphus oenoplia			3	3	3	1
9.	Diospyros melanoxylon			3	2	3	2
10.	Albizzia amara			3	2	2	1
11.	Soymida febrifuga	٠,	A FE	333	2	2	1
12.	Pongamia glabra	ô		3	3 2	1	1
13.	Gymnosporia montana			2	1	1	1
14.	Acacia arabica	٠.		3	2	2	2
15,	Acacia leucophloea	٠.	Wil	3	2	2	2
16.	Azadirchta indica	٠.	LILL	3	2	2	1
17,	Mimosa hamata	٠,	3.44	3	3	3	2
18.	Acacia ferruginea	٠.	(Cite)	3	3	2	2
19.	Sterculia urens	٠.	स्यम	3	3	3	2
20.	Mitragyna parvifolia	٠.	••	2	1	1	1
21.	Grewia pilosa	٠.		2	1	1	1
22.	Erythrina indica	٠.		1	1	1	1
23,	Dalbergia paniculata	٠.	••	1	1	1	1
24.	Anogeissus latifolia	٠.	••	4	5	4	1
25.	Garuga pinnata	٠.	••	3	2	2	1
26.	Euphorbia nerifolia	٠.	• •	1	1	1	1
27.	Gmelina arborea	٠.	• •	1	1	1	1
28.	Schrebera swietenioides	٠.	••	••	••	••	••

A=Abundance; D=Dominance; F=Frequency; S=Sociability

11. CONCLUDING REMARKS ON FLORA AND VEGETATION OF KHANDESH

Phytogeographical Considerations:

Majority of genera in central Satpudas in Khandesh are either Tropical or Subtropical, semi-green types or dry deciduous types. In central

Satpudas in Khandesh, they are not at all continuous but are confined to Raver ranges and to isolated tracts of forest in Akrani. In areas like Taloda and on Toranmal plateau only dry deciduous species are found. In them the sub-tropical elements are dominant. In older areas like Betul, Gavilgad, Mahadeo hills, tropical elements are seen here and there. In still younger areas near the coastal plains of Tapi in the vicinity of Surat, Dhadgaon plateau, Taloda, some tropical species are found localised. No endemics were noted. But plants like Capparis decidua, Cassia auriculata, Clerodendron phlomoides, Helicteres isora, Vitex negundo are localised at places. They gradually extend their limits. Many changes in climate have taken place due to rise of Himalayas, formation of Rajasthan desert and progressive desiccation of the North India in different geological areas. All these must have affected the climate of Khandesh, Vindhyas and Satpudas. The present day pattern of distribution, therefore, is the result of climate, soil and altered geological and geographical changes, possibly by the segregation of eco-types to suit semi-arid conditions. Many of course must have died in course of time.

The various elements that have entered the flora here arc (1) Afro-Arabian, (2) Indo-Malayan, (3) Himalayan, and (4) Indo-gangetic.

12. TORANMAL HILL AND CRATER LAKE

Khandesh Satpudas extend geologically from Akrani taluka to Raver taluka. They are different than the Vindhyan-Satpudas in Madhya Pradesh, inasmuch as they are all derived from Deccan trap. The Toranmal hill constitutes a special feature of Khandesh. It is a tall hill surrounded by low hillocks 100'—150' (30—45 Mtr.) in height. Similar flat tableland occurs on another hill tops, but they are very small at the north-west end of plateau. There is a precipitous ridge with a straight scarp 400 '(121 Mtr.) in height. There is a lake at the centre of it from which the water falls in the valley and forms Sitakund of variable depth and shape. It bears an impression of a mighty convulsion of earth in the past. To the south of Toranmal hill near the lake there is a cave 12 sq. feet (4 Mtr.) in which there are some Jain temples and idols. The first throw of lake water down the valley is 243' (73 Mtr.).

Toranmal is about 16 sq. miles (41 sq. km.) and its height is 3320' (1009 Mtr.). There are ruins of old fortifications and walls of this lake. According to Dangerfield (1921) Mem. Geo. Survey India, Vol. 6, 1921 p. 107, it is an ancient crater lake. Toranmal plateau lies at 21° 52' North latitude and 74° 34' East longitude. Altitude on the eastern side of the lake is 3373' (1031 Mtr.). It is the highest point of Toranmal The lake is 1.75 miles (2.70 km.) in circumference, 650 yards (594.360 Mtr.) in breadth. Its depth in the centre was found to be 134.5 feet. (40 Mtr). It is filled with rain water, by creating an artificial obstructure to the gorge between two small hills, like that for the Charlotte lake of Matheran. Rain water gets collected in it. There is also a smaller lake about 30' a few hundred yards away from the larger crater lake. The overflow waters from both the lakes rush in the valley to Sitakund by a cascade '400-500' (121-152 Mtr.) deep, the fall being 243' (73 Mtr.) straight. This is the largest summit of mountain in Khandesh. A hill station is being established there but by continuous erosion of the top lateritic soil gets washed off year by year. It needs to be conserved by plantation of some shrubs and trees, otherwise it will become very barren. Hot winds from the plains also visit the hill in summer.

There are dry deciduous plants like Zizyphus rogosa and Phyllanthus emblica. They predominate. It is quite likely that the hill may be reafforested if properly planted. The common tree species seen on it are: Sterculia urens, Cochlospermum gossypium, Mitragyna parvifolia, Zizyphus jujuba, Z. oenoplea, Anogeissus latifolia. Due to extreme cutting of tall trees Latana camara, Vitex nigundo, Butea monosperma have occupied the area.

13. ORIGIN OF SATPUDA FLORA

The exact geological period during which the Satpudas arose is not decided. The great amount of material derived from gneissic rocks is no doubt present in parts of eastern Satpudas in Betul and is similar to that in other parts of the Vindhyas. But the western Satpudas are basaltic in origin. The Satpudas in Mahadev hills are horizontally bedded sandstone or metamorphic rocks. They are quite different from the basaltic rocks in Khandesh of vulcanic origin. Transitional rocks are noticeable in the eastern Satpudas. The Mahadev hills are perhaps, like the Talchirs of lacustrine origin. Narmada valley in upper part is essentially of this type, but these Satpuda ranges join basaltic ranges in Tapi valley. The fossils in the Betul area, as well as the alluvial valley of Tapi are poorly known. Despite the two parts of Satpudas those belonging to Vindhyan series and those belonging to Deccan traps, they form a continuous chain of mountains.

A study of the plant elements in the Satpudas in Khandesh clearly indicates the presence of diverse elements such as Indo-Malayan, Afro-Persian-Arabic from Western Maharashtra. It is difficult to assume that they all have come at the same time. They must have come by different routes in different periods. For example, Indo-Arabic elements must have come by the Punjab, Sindh, Rajasthan desert route and diversified in flat Indo-Ganga plain and thence they might have come here. Similarly, Himalayan, Alpine plants now confined to high altitude also must have come by different routes in succession. Indo-Malayan plants which form a substantial part of the flora and vegetation of North-West Burma and of North-East region of India-Assam, must have come down through the Garo Rajmahal gap to Parasnath and thence into the Indo-Ganga plain and then they might have come right down to Vindhyas. From the Vindhyas they appear to have migrated by Satpuda trend to the Western ghats or the Sahyadris and continued to migrate southwards, till they found a suitable home where they could settle well climatically right down to Palneys and Kodai-Kanal hills which are an eastward extension of the western Ghats. There are many evidences to show that this has happened so. These have been marshalled together by Dr. Sunderlal Hora (1949) gathering evidences both from animal and plant distribution in the form of his well known "The Satpuda Hypothesis".

14. SATPUDA HYPOTHESIS (DR. S. L. HORA)

This hypothesis was formulated by Dr. S. L. Hora, the well-known Zoologist and Pisciculturist. It explains how the Malayan plants and animals have come to Peninsular India. For this, he suggested a highway for the immigration of animals and plants along the Satpuda trend of mountains. According to him the present day fishes found in Peninsular India such as *Bhavamia*, *Silurus*, *Thynnichthys* show Malayan affinities and are the products of rapid speciations. Some typical torrential fishes show discontinuous distribution from Yannan to the Eastern Hills of Assam bridging Garo-Rajmahal gap to Vindhyan-Satpudas,

thence to Deccan-Satpudas, and further down the Western ghats. This immigration of Himalayan fishes is supposed to have taken place not much before the Pliocene period when the climatic and physiographic and fluctuating conditions facilitated rapid speciation and migration. The present day fish isolate in Peninsular India persisted in some places, but today are far apart from each other, mostly in mountain ranges which provided favourable ecological conditions for their survival subsequently. Their distribution is discontinuous and restricted, probably as a result of disturbed orogenesis. The early streams in which they originally lived might have been captured by other streams. Similarly there are some molluses like *Litholis* which are found at Cherapungi and in Maharashtra on mango trees in hilly regions.

The idea that the Malayan element is present in the flora and fauna of India was put forward by Clarke (1898) in his essay on the "Subareas of British India". According to him the different component elements were introduced in the flora of India, one after the other. For example, the sub-order Mapanieae of Cyperaceae belongs to the Eastern countries. Hypolytrum occurs in undisturbed continuity from Malaya to Sikkim. Apparently the various parts of Satpudas, Eastern and Western, have undergone physiographic changes right from Gondwana era to present day time. The Western Satpudas have hard grey trap rocks as its basic material in Akrani and Taloda, but it is soft amygdolidal trap in Shahada, Shirpur, Chopda and Yawal. The Satpudas in Mahadev hills are composed only partly of traps. It is believed that the river Narmada once upon a time joined the river Tapi in Khandesh. Consequently the lower part of Narmada valley underwent changes in the levels in the post-Tertiary periods. Different views are prevalent regarding deposits of Narmada alluvion. This altered the drainage conditions, produced many lakes joined to each other. These, of course, changed the flora and fauna.

The origin of Satpuda flora is thus due to diverse elements and changes of climate and terrain.

15. ECONOMIC IMPORTANCE OF KHANDESH FORESTS

Khandesh forests in point of timber resources were once very valuable. The teakwood from Chopda, Yawal, Shahada, etc. was very famous locally. The yield has however dwindled in the last about 30 years. The dry scrub or thorn Savannah yields some important economic products such as gums, resins, cutch or kath, volatile or scented essential oil, bidi leaves, mohuwa flowers, etc.

A. Gums and Resins:

These are: (1) Gum kadaya—obtained from Sterculia urens used in textile industry and in confectionary, (2) Gum arabic—obtained from Acacia arabica etc., (3) Gum Ghati—obtained from Anogeissus latifolia often used as an adulterant in gum arabic, (4) Gum-resin of Boswellia Serrata sold in the market as 'Dhupa'. Also a gum resin obtained from Commiphora mukul is sold being very scented and medicinal. It is known as Guggul and used in Ayurvedic preparations.

B. Flowers of Mohuwa:

Flowers of mohuwa or Bassia latifolia used as a cheap material in brewery, especially in Rum making.

C. Kath or Cutch:

This is mostly obtained from the heartwood of Acacia catechu and A. suma. It is used in Calico Printing Industry for printing jajam (cloth carpet) mainly in Jamner area of Jalgaon. It is used mainly in chewing betel-leaf.

D. Bidi Leaves:

These are now the monopoly of the State and a source of income to the Forest Department. It yields a revenue of Rs. 394.91 lacs or more to Maharashtra Government from *Tendu* or *Diospyros melanoxylon* Roxb.

E. Essential Oil yielding grasses:

Several grasses in India are odoriferous-Cymbopogon martini Watts.—Previously known as Andropogon schoenanthus var Martini Hook. f. is the best of them. It is known as Rosha grass or T. khadi. It is found growing all over India. It is abundant in Khandesh, Vidarbha, Nasik, Melghat, Betul, Panchgani etc. It has two varieties, not easily recognizable, Motia and Sofia. The latter forms distant patches but Sofia grows gregariously over large areas. Their oil at times is recognised as "Ginger oil". It is extracted in Khandesh in crude stills by distilling. Green grass yields 0.3% oil with 50—60% of moisture. Sun dried grass has less moisture 28% but yield is more 1.25%. Sofia grass gives better yield.

Rosha or Palm rosa oil is used in perfumery as a source of geraniol and is used in many essences and in medicine. It is exported to European countries, especially France. Bombay is the chief exporting centre in India.

Another species of Cymbopogon nardus Linn yields Citronella oil. It is mostly cultivated in Nilgiri hills of Madras, rarely in Maharashtra.

Indian Rosha oil has total 78—94% geraniol, free or combined. It is its main constituent. It is soluble in 3 volumes in 70% alcohol. Besides geraniol it contains a few other constituents. Oil prepared in Khandesh has 85% geraniol, but the one prepared in Melghat, Ellichpur, Burhanpur has 90—95% of geraniol oil. (For reference See Wealth of India. Vol. 11, pp. 416—418. CSIR Publication).

16. UNABDEV HOT WATER SPRING

At Unabdev near Chopda in Jalgaon district there is a remarkable hot water spring under Satpuda hills adjacent to an old temple of Murlidhar built about 200 years ago. The spring is laid by underground conduit into a square pond through a gomukh or cow's head made up of black stone. Hot water having temperature of about 140° F. gushes out of it into the pond. The algal flora of this place or the radio activity of the hot water in this spring have not been studied like those of kunds at Vajreshwari in Thane district or those near Chiplun.

Like Unabdev there are hot water springs at Sunabdev and Najhardev in Chopda taluka. Najhardev is about 3.2 km. from Sunabdev. All these springs flow through underground sources not traceable. The water temperature in these hot water springs varies from 85–103° F. in the morning. The water in them has slight sulphurous smell but it is less in Unabdev spring waters. The surrounding country of Satpuda is very hot where temperature reaches 113° F in summer.

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सन्धमेव जयते

SECTION C-FLORA OF VIDARBHA

1. INTRODUCTION,

Vidarbha stands on an upland plateau having nearly 457-Z-548.6 metres elevation above M. S. L. It is a continuous stretch of land with black cotton soils derived from the Deccan Trap basalt. The plants on it are similar and also the flora. It lies in the valleys of Wardha, Vainganga, Katepurna and Purna rivers. Its eastern border however has different soils and also the rainfall pattern. The vegetation in general is of the dry deciduous type and semi-evergreen in certain places. There are also areas where only shrub is there as in Ahmednagar, Sholapur and Marathwada districts. For the most part, it is a kind of dry woodland Savannah. There is an admixture of a few evergreen a species with dry deciduous species as in Khandesh, particularly in Nagpur, Bhandara and Melghat areas. For example, Tectona grandis and Gardenia lucida grow with Hardwickia binata as in West Khandesh. But such situations are very few in the main forest belt of Western Maharashtra. Similarly in a number of places Anogeissus latifolia or A. pendula grow together with Adina cordifolia. The greatest part of Vidarbha flora in Amravati and other districts to the west of river Wardha is similar to that in Desh part of Maharashtra, but in Bhandara, to a certain extent in Nagpur; and much more in Chandrapur, one sees several elements growing together from the flora of Upper Gangetic plain, flora of Khandesh, flora of Bastar district in Madhya Pradesh, and from the flora of Orissa. This is probably because of the gaps in Satpuda mountains through which the plants of Vindhyan region have come down to Maharashtra. The dry deciduous elements in the forest are more or less common. Their abundance and growth however in different parts of it are not the same. For example, the trees of Tectona grandis growing in the valleys of Sahyadris are small in size, e. g., on the slopes of Igatpuri ghat, Khandesh, and in Nagpur. But in Chandrapur they reach their optimum growth. There are different associations of Tectona grandis in which Tectona grandis grows well. It is the main timber species in all parts of Maharashtra including Chandrapur forests of Vidarbha.

As regards the general flora, there are hardly 50 to 60 species in the flora of Vidarbha which are different from those in the remaining Maharashtra, but there are many different herbs. The shrubs numbering about 50 are common; but those in the ghat forests of Western Maharashtra are not seen in the flora of Vidarbha, e. g., Gnetum ulva, Carvia callosa various species of Strobilanthes.

2. LACK OF ENDEMIC ELEMENTS.

In the flora of Western Maharashtra there are at least 40 endemic or very rare species, but in the flora of Vidarbha no such endemic species, hardly a few, have been recorded. This shows that flora from the one end of Maharashtra to the other end right upto Guon, Indore and Jabalpur is of a similar nature. Only exception to this to a certain extent is the flora of Chandrapur. This is because of its contiguity with the districts from other States around it. It is the only area where Teak or Tectona grandis is self-sown. But it has no Shorea robusta belts, as are found in the forests of Bastar, Beladila, Jagadalpur areas, etc. This fact and dissimilarity of flora, are indicative of the ancient nature of flora in which Shorea robusta was widely spread in Peninsular India in the past. The very vigorous growth of Tectona grandis and other woody species as found in Vidarbha is not seen in other parts of Maharashtra.

A-127-24-B.

A perusal of the list of plants in Nagpur, Ramtek, Melghat, Amravati and Chandrapur areas clearly shows that there is a large number of herbaceous species here, whereas in the flora of Western Maharashtra the shruby and woody species of Strobilanthus, Carissa and other shrubs are highly conspicuous. The shrubs on the top of ghats are rather sparse in the flora of Vidarbha. Though they are plentiful in a few areas. Their place in Melghat is taken by bamboos. The trap hills around Nagpur, Bhandara and other Vidarbha districts are covered in monsoons by herbaceous ground flora in a spectacular way, and even afterwards. In the semi-arid regions of Khandesh and Marathwada monsoon ephemeral flora constitutes a characteristic feature of the flora of the whole Maharashtra except Konkan. Throughout Peninsular India this is a grand sight after the rains, but they all die as soon as the temperature begins to rise in October and soils get depleted of moisture.

The Monsoon ephemeral flora is characteristic of Andhra Pradesh, Madhva Pradesh and Maharashtra, i.e., of the plateau of Peninsular India.

Flora in the Narmada basin is also characteristic, but it contains elements both dry and moist woody species, and some monsoon ephemeral plants in the lower part of the Narmada basin.

In point of economy of the Maharashtra State, the forests in Chandrapur district of Vidarbha are the most important, since the rich forests of Dangs have been conceded to Gujarat. They are also a part of the Deccan tableland. Various plant products are obtained from Chandrapur.

There is scope for further exploitation and exploration of them. A number of places in Vidarbha such as Warora, Naduri Budruk etc. are heavy coal mining areas below the forests which on the surface look so unpromising, but there is coal. At Ballarshah there is a paper mill and many wood saw mills. However no attempt seems to have been made for the introduction of new woody species that could thrive here, particularly from the forests in the foot hills of Siwalik Himalayas where similar dry deciduous forests do occur. It is very likely that some pines from the Caribean Sea Islands and plants like Englehardtia, desert species of Acacia and Eucalyptus from Australia will grow well here.

3. CITRUS FRUIT CULTIVATION IN NAGPUR REGION.

The rivers in Vidarbha as a rule are shallow, flowing as they do through hard Deccan Trap rocks. Naturally they do not have much alluvium, but the soils around Nagpur right upto Sausar, alternation of very cold climate in winter followed by hot summer, enough humidity, are very favourable for the plantation of Citrus fruit trees. Nagpur is famous all over India for citrus fruits. Here they generally do not fall a prey to the severe Die Back disease of Citrus, as do the plants in Rahuri area in Ahmednagar district.

4. CLIMATE OF VIDARBHA DISTRICTS.

Vidarbha comprises eight districts (1979-80), Buldhana, Yeotmal, Akola, Amravati, Wardha, Nagpur, Bhandara and Chandrapur. Of these, the climate of seven districts except Chandrapur is somewhat similar. The northern and western parts of Vidarbha are climatically similar, but the eastern and southern parts of Bhandara and Chandrapur are rather different. The climate is hot and dry in the seven districts mentioned above, as they are a continuation of Marathwada and Desh part of Western Maharashtra.

I. Gadhachiro'i has subsequently been constituted into a separate district.

District Buldhana:

This district has hot summer and well distributed rainfall due to South-West Monsoons. It is generally dry in winter from December to February, and hot in summer—March to June. The average rain-fall is 796 mm. It is more towards south than towards north. Buldhana, Dhamangaon area at the north-west gets more rainfall. July is the rainiest. The number of rainy days is 47. October to November is post-monsoon period and it also brings some rain. The annual mean temperature is 38.3°C (100.9°F). In May, the maximum temperature goes upto 43.3°C (109.8°F). The daily minimum is 27.4 °C or 81.30°F. In summer the heat is very severe, reaching sometimes 116.6°F or 47°C in the northern part. Humidity in monsoons is high but in the rest of the year, it is dry. A special feature of the climate here are the monsoon depressions arising from the cyclones in the Bay of Bengal and moving westwards with very widespread heavy rains. The post-monsoon storms and depressions from the Bay of Bengal affect the weather.

District Yeotmal:

The climate of this district on the whole is hot and dry. There are rains from June to October and also in the post-monsoon period in November. Annual rainfall due to S. W. monsoon for the whole district is 991.6 mm. It increases from north-west to south-east. Near the northern border town of the district has 896.3 mm. rain. South-east border town of Pandharkavda gets 1122.2 mm. rain. Variation in the rainfall from year to year is large. In about 50 years the rainfall is subnormal once or twice.

The mean daily maximum temperature at Yeotmal is 41.8°C (107.2°F) and the mean daily minimum temperature is 28.3°C (82.9°F). In summer the heat is intense, the maximum temperature goes to 47°C (116.6°F). December is the coldest month, daily minimum temperature reaching 15.1°C (59.2°F); maximum is 28.4°C (83.1°F). Western disturbances from the sea and north India set up cold waves which affect the district. Summer months are very dry. Other months except rainy season are also dry. Depressions in the Bay of Bengal cross the district at any time. S. W. Monsoon is highly speedy. Gusty winds generally blow in October and November.

District Akola:

Akola is the hottest and driest district of Vidarbha. The average annual rainfall for it is 846.5 mm. It increases from north-west to south-west and varies from 767.3 mm. at Telhara on the north-west border to 926.8 mm. at Washim on the south-east border. Annual rainfall for the district is 600—1100 mm. Once or twice in fifty years, it is much less. The number of rainy days is 48. Daily temperatures are very high and heat is intense in summer; but nights are cool even in April. The day temperature goes upto 46-47°C (114.8°-116.6°F). Thunder storms are not unusual in summer. There is a secondary maximum temperature rise during day time in October. The temperature rises rapidly after February. The highest maximum temperature recorded at Akola is 47.8°C (118°F) on May 22, 1947. Its peculiarity is that it lasts for more than 12—14 hours during a day here. Monsoon depressions originating in the Bay of Bengal move westwards bringing stormy winds and wide spread rainod up sst-monsoon months.

District Amravati:

There is dryness in the air throughout except during monsoons. The average rainfall for the district is 887.4 mm. in the plains. Rainfall in the hills like Chikhaldara is generally twice as much as this. July is the rainiest. The number of rainy days in plains is 49, but at Chikhaldara they are 77. Mean daily maximum temperature at Amravati is 28.6°C (83.2°F) and the mean daily minimum 15.1°C. At Chikhaldara the maximum and minimum are 22°C (72°F) and 13°C (55°F) respectively. Westerly disturbances from North India, and cold waves affect the district. Then the temperature goes down to 5°C but begins to rise rapidly from February.

District Wardha:

The climate here is like that of adjoining districts hot and dry. Average annual rainfall for the district is 1090.3 mm. Rains last from June to September. July is the rainiest. The number of rainy days is 56. May is the hottest month and December the coldest. Daily maximum temperature goes upto about 42.0°C (107.6°F) and daily minimum is about 28°C (82.4°F). But in certain places daily temperatures could be higher than the average. In summer especially they rise to 47°C (116.6°F). Heat in summer is severe but the nights are cooler. After June there are thunder storms which bring down the temperature. Western air disturbances and cold waves from North India affect weather bringing very cold winds when the night temperature goes down to 5°C (41°F).

District Nagpur:

Summer is very hot and weather dry. The average annual rainfall in the district is 1161.7 mm. It is well distributed increasing from west to east. It is highest in July. 90 percent of it comes in June to September. The number of rainy days is 59. November and December are cold months. December is the coldest. Daily maximum temperature is 28.7°C (83.6°F). May is the hottest month when the mean maximum temperature goes to 42.7°C (108.8°F). Nights are relatively cool. The thunder storms begin to increase with the beginning of monsoons in the second week of June and the heat goes down. The minimum temperature in winter can be as low as 4°C (39°F). Winds are moderate.

District Bhandara:

The summer is very hot and dry. The annual rainfall is 1470.6 mm. It increases from West to East. It is very variable, 1312.9 mm. at Chandpur, to 1578.5 mm. at Gondia towards the places at the northeast end of the district. They begin in the second week of June, July and August have heavy rains. Once in 4—10 years the rainfall is less or more once or twice. However, it is well distributed. The number of rainy days is 63.

The mean maximum temperature for the district is 27.7°C (81.9°F). The mean daily minimum is 13.1°C (55.6°F). The minimum temperature sometimes goes down to 7°C (44.6°F). May is the hottest month. December, January are the coldest. In May the maximum temperature rises as high as 42.1°C (107.8°F). Thunder storms are common in summer. The rainfall is mostly due to S. W. monsoons, some to N. W. monsoons. Winds begin to blow from south-west to north-west during monsoons, and in the riverse direction in the post-monsoon period.

The thunder storms are common in June and also towards the end of monsoons. The disturbances from the Bay of Bengal cross the district and affect the weather.

District Chandrapur:

The district is quite hot in summer, and there is general dryness in other months, but not in monsoons. The rainfall is due to S. W. monsoons and also due to return monsoons and from the Bay of Bengal. It is well distributed. The average annual rainfall for the district is 1420 mm. It increases from west to east and varies from 1184.8 mm. at Warora to 1826.5 mm. at Murumgaon. The number of rainy days is 63. December is the coldest month, when the temperature goes to 28-2°C (82.8°F). The mean daily minimum temperature is 11.6°C (52.9°F). Daily mean maximum temperature in the Southern half of the district is 29.8°C. It rises rapidly after February, and May is the hottest month of the year. In May the mean daily maximum temperature rises to 43°C (109°F), and the minimum to 28.9°C (82.4°F). Summer is intense. Occasionally the temperature rises to 48°C (118°F). There is a secondary peak rise in temperature in October. In December temperatures fall rapidly. The highest temperature at Chandrapur was noticed in May 1912 to be 118.9°F or 48.6°C. At Sironcha also the temperature rises very high in May to 46.7°C (116.1°F), which in December comes down as low as 2.8°C (37°F) and weather becomes very cold. At Chandrapur they go down to 7.8°C (48°F). Other places have similar temperatures. Humidity during monsoons S. W. and N.E. is pretty high, even in the post-monsoon period. Thunder storms occur in all weather. In December the temperature at Chandrapur is 27.2°C (80.9°F). The daily maximum temperature 94°F and minimum 93°F or 23°C. The heat is very severe in May, but the nights are much cooler. In the late May and in June there are thunder storms. They are due to depressions coming over from the Bay of Bengal and crossing the district.

5. FLORA AND VEGETATION OF VIDARBHA.

Works on the flora of Vidarbha as a whole, are practically nil and there is no authoritative text on the flora. So far, only some lists of plants in different parts of Vidarbha are available and stray references to them in literature. As early as 1887 Van Somaran had published "A list of trees in Melghat Forest' giving account of 110 trees. Diackon had prepared "A list of species in Berar Circle" followed by "A list of trees, shrubs and climbers in the northern circle of Central Provinces". But none of these are available, not being published. Utilising these Witt (1908) prepared a more comprehensive "List of trees, shrubs, climbers and other plants of economic importance found in Berar Circle of the (then) Central Provinces", about 266. A descriptive list of trees, shrubs and economic herbs of Southern Circle of the Central Provinces was made by Graham (1911) particularly of Nagpur Plants, about 309, and another by Haines (1916). These were the only authoritative lists. Recently, however, R. I. Patel (1964) has published a book on "The Forest Flora of Melghat" which is really a junction of several ghat areas around. It should be considered as representative of the plants in the hilly areas and ghats in Vidarbha, their slopes and nearby plains. Patel (1964) has given an account of the trees and shrubs belonging to 716 species of angiosperms spread over 86 families, and of 7 introduced species of conifers in Melghats which is an important forest region of Vidarbha. Balapure (1966) has been working on Nag-Vidarbha, Ramtek flora. He estimated about 2000 plants in old Central Province.

The hill station of Chikhaldara lies in the Melghat area and the Project Tiger Sanctuary of Kolkaz is near Chikhaldara. These may be taken fairly representing the flora and vegetation in the plains, hills and valleys in Vidarbha. Recently Malhotra and Moorthy (1971) have described species in Chandrapur District. It is obvious that the flora here is very rich containing dry deciduous, semi-evergreen and some moist evergreen species. The well known tiger and wild game Reserve, Tadoba Sanctuary, lies in Chandrapur. According to Balapure (1936) there are at least 2000 plants in Vidarbha. Special features of Chandrapur are six Forest Divisions in the single District of Chandrapur. The teak (Tectona grandis) and other timber species grow here very luxuriantly and yield highest revenue to the State. The growth of timber trees here is very luxuriant as can be seen from the sta ement below. In Chandrapur Tectona grandis grows to 114—140'. Elsewhere Tectona grandis (Teak) grows only about 50—60' in height, e.g., in Nasik, Dangs and Khandesh forests. In North Kanara it grows to 70'.

6. GROWTH OF DIFFERENT TIMBER TREES IN ALLAPALLI FOREST RESERVE, CHANDRAPUR DISTRICT (AS GIVEN BY CHADRAS, 1962).

	Name			3	Height (in feet)	Girth (in feet)
1.	Tectona grandis				141	13
2.	Tectona grandis	IN	THUY	٠,	136	6-7
3.	T. grandis	140	THE		116	8-11
4.	T. grandis	66		١	115	11-9
5.	Adina cordifolia			2.	115	10-3
6.	Tectona grandis		200	٠	114	17
7.	T. grandis	सन्ध	पेव जयते		114	11-10 1
8.	T. grandis				113	14
9.	T. grandis				113	13-10
10.	T. grandis		• •		113	12-7
11.	Stephegyne parviflora	• •		•1•	91	13

On the whole the vegetation in Vidarbha is of the dry or mixed deciduous type in which *Tectona grandis* predominates. The vegetation however changes and assumes different facies according to location, topography, soils altitude, rainfall, humidity etc. in different months of the year.

7. PLANTS OF MELGHAT.

The list of plants in Melghat is given on pages 376-87. The main hill station in Vidarbha is that of Chikhaldara. It lies at the south-east end of Vidarbha. It is 10 km. in extent where Ougenia oojeinensis Linn. Emblica officinalis Gaertn. Terminalia chebula Retz, Syzygium cumini (L) Skeels, Ficus glomerata Roxb. Careya arborea Roxb., Mangifera indica Linn. and Zizyphus rugosa Lamk. grow. The canopy is formed mainly by Ougenia oojeinensis, Zizyphus xylopyra Willd. Wrightia tinctoria Br. form second layer. Small shrubs grow here and there.

In the drier parts Anogeissus latifolia Wall, Dalbergia paniculata Roxb. Butea monosperma (Lamk) Jaub. Hardwickia binata Roxb., Tectona grandis Linn., Sterculia urens Roxb., and Acacia sps. occur. Mostly these are secondary species. Undergrowth is of grasses like Schima sulcatus (Hack.) A. Kamas., Apluda mutica and Symbopogon martini (Roxb.) Watg. Bamboos cover large tracks of slopes in drier areas. They are Dendrocalamus strictus, and in valleys, Bambusa nana. Lantana camara occupies large tracks of forest lands, and forms dense thickets. The other associates of it are: Helicteres isora (Vaghl.) R., Nyctanthes arbor tristis Linn, Pogostemon pletranthoides (Vahl.) R. Br. and Vitex negundo. Ten dominant families in the Melghat area are:—

				Genera	Wild species-		Cultivated
1.	Leguminoceae	• •	• •	24	53	+	7
2.	Acanthaceae			12	20	+	8
3.	Rubiaceae			20	24	+	1
4.	Malvaceae			9	21		
5.	Verbenaceae	• •		10	16	+	6
6.	Apocynaceae		~ 5	FEAIL	10	+	3
7.	Caesalpinaceae			然 拒合。	20	+	2
8.	Compositae			7.5	10	+	7
9.	Asclepiadaceae		£53	₹ 7	8		
10.	Rhamnaceae		date	7	8		

The list of plants in Melghat clearly indicates the dry deciduous nature of vegetation similar to that in other parts of Maharashtra. It is in no way different from it in the composition, but *Tectona grandis* is often mixed with *Hardwickia binata* and *Adina cordifolia*. The former is indicative of dry habitats. The plants of Nagpur, Ramtek and around are like those of many other semi-arid places in Maharashtra, but because of higher rainfall there are many ponds in this region, some permanent and some temporary, drying after monsoons.

Flora of Melghat (After R. T. Patel, 1968)

Name	Flowering season
1. Ranunculaceae Clematis triloba Heyne	October-November
2. Dilleniaceae Dillenia indica Linn. (Dillenia pentagyna Roxb.)	June-July April—Sept.
3. Magnoliaceae Michelia champaca Linn.	April—September
Anonaceae:	Mav—July

March—May

May-June

Miliusa velutina H. and T.

(M. tomentosa (Roxb.) Sinclair)...

Name	Flowering season
Menispermaceae: Cissampelos pareira Linn. Cocculus hirsutus Desl. Tinospora cordifolia Miers	July—October November—February April
Papaveraceae: Argemone mexicana Linn	Throughout the year (weed).
Capparidaceae: Gynandropsis gynandra (Brig.) (Crataeva religiosa Forst.) Maerua arenaria Hook. f. and Thomas. Capparis spinosa Linn. C. grandis Linn.	December—April March—May Cold season February —June April—October
Bixaceae: Cochlospermum religiosum Linn. Flacourtia indica (Burm. f.) Merr.	January - April January - March
Portulacaceae: Portulaca oleracea Linn	October—December
Tamaticaceae: Tamarix gallica Linn. (T. dioica Roxb.) T. ericoides Rottl	November—February November—February November—February
Malvaceae: Malvastrum coromandelianum Garcke.	September
Sida veronicaefolia Lamk. S. glutinosa Cav. S. spinosa Linn. S. acuta Burm. S. rhombifolia Linn. S. cordifolia Linn. Abutilon indicum Sw. A. glaucum (Cav.) Sw. A. graveolens Wight and Am. Urena lobata Linn. (U. sinuata Linn.) U. repanda Linn. Hibiscus ficulneus Linn. H. micranthus Linn. H. esculentus Linn. H. cannabinus Linn. Abelmoschus micranthus Linn. Abelmoschus manihot Linn, Medik.	September—November August—December August—October August—December July—September August—October September—November September—November September—November August—November September—November October-November October-November October—November September—November September—November October—November
Kydia calycina Roxb Salmalia malabarica (DC) Sch. and Endl.	August—November February—March
Sterculiaceae: Sterculia urens Roxb. S. villosa Roxb.	December—February March—April

Name	Flowering season
Firmiana colorata R. Br	March-April
Helicteres isoza Linn	June-December
Eriolaena hookeriana W. and A	March—July
Tiliaceae:	
Grewia orbiculata Rottl	April
Grewia damine Gaertn	July-August
G. tiliaefolia Vahl G. asiatica Linn	May—July
G. asiatica Linn	March—May August—October
G. hirsuta Vahl	July-September
G. abutifolia Vent. ex Jun.	June-July
Triumfetta rhomboidea Jaeq	August—December
T. rotundifolia Lam T. pilosa Roth	August—December September-October
Corchorus olitorus Linn	B-promosi October
Zygophyllaceae: Tribulus terrestris Linn	Throughout the year
Tributus terrestris Limi	Throughout the year
Rutaceae:	`
Feronia limonia (Linn.) Swingle	February — May
Aegle marmelos Correa	April—June May—September
Murraya paniculata (Linn.) Jack. Murraya koenigii (Linn.) Spr	March—April
Simarubaceae:	,
Ailanthus excelsa Roxb	February-March
Balanites aegyptica Linn. Delile	March—May
Bursaraceae:	37
Boswellia serrata Roxb	January—April
Garuga pinnata Roxb	February—April
Commiphora wightii (Arn.) Bhan- dari.	February—April
•	
Meliaceae:	March Marc
Melia azadarach Linn	March—May March-–May
Soymida fibrifuga A. Juss	March-April
Cedrela toona Roxb	March-April
Chloroxylon swietenia DC	March-April
Olaçaceae:	
Olax scandens Roxb	April—June
Cansjera rheedii Juss	November-December
Celastraceae:	
Celastrus paniculata Willd.	April—June
Gymnosporia spinosa (Forsk) Fiori.	October-November
Elaeodendron glaucum Pers.	
Rhamnaceae:	T\$7' 4
Ventilago calyculata Tul Zizyphus oenoplia Mill	Winter August—September
Z. mauritiana Lamk	September—November
Z. nummularia W. and A	March—June

Name	Flowering season
Z. rugosa Lam	April-May
Z. xylopyra Willd	JanuaryApril
Helinus lanceolatus Brand	January—April
A malting of	
Ampelidaceae: Leea macrophylla Roxb	July-October
Leea edgeworthii Santapau	July—September
Ampelocissus latiyolia (Roxb.)	outy September
Planch.	
Cissus quadrangularis Linn	July-September
Cissus repanda Vahl	April-May
C. setosa Roxb	July-August
Cayratia carnosa Gagnep. (Cayratia auriculata (DC) Gam.)	July-August
(Cuyrana auriculata (DC) Gam.)	
Sapindaceae:	
Cardiospermum halicabum Linn.	September—November
Schleichera oleosa (Lour.) Olkeen	August-September
Sapindus laurifolius Vahl	October—December
S. emarginatus Vahl. Dodonaea viscosa Linn.	October—December
Dodonaed viscosa Linn	Monsoon
Anacardiaceae:	(F) (F)
Semecarpus anacardium Linn	
Mangifera indica Linn	February—May
Anacardium Occidentale Linn	P197
Buch anania lanzan Spreng	January—March
B. angustifolia Roxb. Spondias mangifera Willd.	January—July February—April
Spondius manggera Willia.	1 columny—April
Moringaceae:	5/1.5/J
Moringa oleifera Lamk	January—April
सन्यमेव	जयते
Leguminosae :	A
Heylandia latebrosa DC Crotolaria mysorensis Roth	August September
C. chinensis Linn.	September
C. sericea Retz	October—March
C. verrucosa Linn	October—February
C. juncea Linn	Cold season
Indigofera linefolia Retz	July—September
Indigofera cordifolia Heyne	August—December
I. denneaphylla Linn T. trifoliata Linn	October-November
I. trita Linn.	August—October
I. glabra Linn.	September-October
I. tinctoria Linn	August-September
I. hirsuta Linn	August—September
I. cassioides Rottl.	December-January
Millettia auriculata Baker	April—June
Tephrosia purpurea Pers	September—November
and Rendl.	October—December,
S. sesban Linn.	September-November
S. grandiflora Pers	All various times
Aeschynomene indica Linn	August-September
	-

Name	Flowering season
Uraria picta Desv	August-September
Alysicarpus vaginalis Linn	September-October
Ouginia oojeinensis (Roxb.) Hooke	
Desmodium cephalotes Wall	
Desmodium laxiflorum DC	Aug-Sept.
D. triflorum Linn	SeptOct.
D. gangeticum DC	July-Sept.
Desmodium latifolium DC	Aug-Sept.
D. motorium (Houtt.) Merr	Aug-Sept.
Abrus precatorius Linn	Aug-Sept-Oct.
Mucuna prurita Hook	Sept—Nov.
Erythrina variegata (Linn.) Var.	Sept 1101.
orientales (Linn.) Merr.	
Erythrina suberosa Roxb	
Butea parviflora Roxb	Cold season
B. monosperma (Lamk.) Taub.	Cold scason
B. superba Roxb	
Pueraria tubersoa DC	Cold season
Atylosia scarabaeoides Benth	June—October
Cylista scariosa Roxb	November—February
Rhynchosia albiflora (Sims.)	October—December
Alston.	October Beechioer
R. minima DC	September—December
Moghamia strobilifera (Linn.) St.	October—December
Hil.	200
M. bracteata Roxb.	August—November
M. lineata (Roxb.) St. Hil	November—January
M. involucrata (Benth.) St. Hil	October—December
Dalbergia sisoo Roxb	March—June
D. latifolia Roxb	January—February
D. paniculata Roxb.	April-June
D. lanceolaria Linn.	April-May
D. volubilis Roxb.	February—March
Pterocarpus marsupium Roxb	May—June
Pongamia pinnata (Linn.) Pierre	April—June
Sub-Family Caesalpineae:	
Caesalpinia bonducella (Linn.) Roxb	
C· separia Roxb	February—May
C. pulcherrima Sw	June-March
Delonix elata (Linn.) Gamble	June-September
D. regia (Bog.) Raf.	April—June
Parkinsonia culeata Linn	October—April.
Cassia fistula Linn	March—June
C. siamea Lamk	AugustMay
C. occidentalis Linn	September—November
C. sophera Linn	August—December
C. obtusifolia Linn	September—December
C. auriculata Linn	OctoberMarch
Harwickia binata Cor	October-January
Tamarindus indica Linn	May-June
Bauhinia racemosa Lamk.	March—June
B. malabarica Roxb	Common throughout
B. retusa Han	September—December
B. purpurea Linn	September—November
B. variegata Linn.	February—April February—June
B. vahlii W. and A	r-eoruary—June

Flowering season Name Sub-Family Mimosae: February—April Prosopis spicigera Linn. ... (Found on the border of Melghat). September—December Dichrostachys cinerea W. & A. ... August—October Mimosa hamata Willd. August---October M. rubicaulis Lamk. Acacia arabica (Lamk.) Willd .. August—December August---March A. farnesiana Willd. A. leucophloea Willd. August—November .. February—April A. jacquemonti Benth. . . August—October . . A. catechu Willd. .. January—April A. ferruginia DC. .. A. lenticularis Buch. Ham. April-May March--July A. rugata Lamk. May—September A. torta Roxb. July—September A. pinnata Linn. .. March-May Albizzia lebbeck Linn. A. odoratissima (Linn.) Benth. .. April—June Mav-June A. procera (Roxb.) Benth. Rosaceae No wild plant, all cultivated. Crassulaceae: June Bryophyllum calycinum Salsb. ... Combretaceae . Terminalia chebula Retz. April-May .. February—Mav Combretum ovalifolium Roxb. .. January—March C. decandrum Roxb. .. February-March Calycopteris floribunda Roxb. ... December—March Myrtaceae: Syzygium cuminil (Linn.) Skeels. May-June March---June Syzygium salicifolium Grah. .. March-April Careya arborea Roxb. ... Lvthraceae: fruiticosa (Linn.) January—April Woodfordia Kurz. Lawsonia inermis Linn. Lagerstroemia parviflora Roxb. .. March—July Onagraceae: Jussiaea subfruticosa Linn. August—October J. perensis (Linn.) Brenan May-June Samydaceae:

Caricaceae:

Casearia graveolens Dalz.
C. elliptica Willd.

Carica papaya Linn. .. Cultivated

May-June

February—May

Name	Flowering season
Cucurbitaceae: Trichosanthes palmata Roxb	Monsoon
Cactaceae: Opuntia elator Mill	
Cornaceae: Alangium salvifolium (Linn.) Wang.	February—April
Rubiaceae: Anthocephalus indicus A. Rich. Adina cordifolia (Roxb.) Book. Mitragyna parvifolia (Roxb.) Korth. Wendlandia excelsa (Roxb.) DC. Oldenlandia corymbosa Linn. Mussaenda frondosa Linn. Randia ulinigosa DC. R. brandisii Gamble Gardenia gummifera Linn. G. resinifera Roth. G. latifolia Ait. Knoxia summatrensis (Retz.) DC. Meyenia laxiflora Robyns. Canthium parviflorum Lamk. Ixora arborea Roxb. Pavetta indica Linn. Coffea arabica Linn. Morinda tinctoria Roxb. Chasalia curviflora Thw. Hamiltonia suveolens Roxb. Borea stricta (Linn.) Schum. Rubia cordifolia Linn.	May—July June—September May-June February—April September—November July—October May—July March—July March—July March—May August—November February—May April—June March—May Introduced.
Compositae: Vernonia cinerea Linn. V. divergens (Roxb.) Edg. Adenostemma lavenia (Linn.) Kuntze. Ageratum conyzoides Linn. Cyathocline purpurea (Don.) Kuntze. Artemisia parviflora B. Ham. A. vulgaris Linn. Blumea obliquea (Rinn.) Druce B. membranacea DC. Xanthium strumarium Linn. Plumbaginaceae: Plumbago zeylanica Linn.	November—January September—November November—January November—January October—December August—December October—December March—May August—October July—September
Myrsinaceae: Maesa indica Wall. Embelia ribes Burm. E. tskriam. cottam (R and S.) DC	December—March February April—July

Name	Flowering season
Sapotaceae: Madhuca indica Gmel. Manilkara hexandra (Roxb.) Dub.	March-April October-November
Ebenaceae: Diospyros melanoxylon Roxb. D. montana Roxb. D. chloroxylon Roxb. D. emdryopterts Pers.	February—April March—May July—September March—May
Oleaceae: Jasminum sambac Ait J. multifltorum (Burm.) F. Andr. J. arboreascens Roxb. J. officinale Linn. J. grandiflorum Linn. Nyctanthes arbor-tristis Linn. Schrebera swietenioides Roxb.	July—September Cultivated in Monsoon April-May May—July March—August August—October August—October
Apocynaceae: Carissa spinarum A. DC C. carandas Linn. Rauwolfia serpentina Linn. Tabernaemontanadivaricata (Linn.) R. Br. Plumeria rubra Sant. & Irani Holarrhena antidysenterica Wall. Wrightia tomentosa Roem. W. tinctoria R. Br. Icnocarpus frutescens Ait. Vallaris solanaces Roxb	MarchMay JanuaryApril November-December MayAugust Cultivated in rainy season MarchJune April June March and April SeptemberDecember NovemberApril
Asclepiadaceae: Hemidesmus indicus (Linn.) R. Br. Cryptolepis buchanani Roem Calotropis gigantea (Linn.) R. Br. C. procera (Linn.) R. Br Holostemma annularis (Roxb.) K. Schum. Pergularia daemia (Forsk.) Chiov. Marsdenia volubilis (Linn.) Cooke Leptadenia reticulata W. and A.	August-September May—June November—July Chiefly in cold season. July—September August —January April—July April-July.
Loganiaceae: Buddleia asiatica Lour Strychnos potatorum Linn	December-February. April-May.
Boraginaceae: Cordia dichotoma Forst Cordia macleodii Hook Ehretia laevis Roxb Rhabdia lycoides Mart	January-March. March-May. February-March.
Convolvulaceae: Cuscuta reflexa Roxb. Rivea ornata Chois. R. hypacrateriform i Chois.	December-January. August-September. August-September.

Name	Flowering season
Jacquemontia paniculata (Burm.) Hall.	October-November.
Argyreia sericea Dab A. strigosa (Roth.) Santapau & Patel.	August-September. October-December.
Ipomoea tropica Santapau & Patel I.maxima (Linn. f) Don. ex Sweet I.pes-tigridis Linn	October-November. August-October. September-November
Solanaceae: Solanum xanthocarpum Schred and Wendl.	June,
Sindicum Linn	August-October.
Physalis peruviana Linn	August-September.
Datura stramonium Linn	September-December.
D.metel Linn	Rainy season.
Scrophulariaceae: No wild plants, Bignoniaceae:	
Oroxylum indicum (Linn.) Vent	May-July.
Dolichadrone crispa Seem D. falcata Seem	March-May. March-May.
Heterophragma quadriculare(Roxb.	
K. Schm.) Stereospermum personatum (Hassk.)	• •
Chatterjee. S.suaveolens DC	March-Mov
Radermachera xylocarpa (Roxb.)	March-May. April-May.
L. Schum.	rapini nanji
Pedaliaceae:	
Martynia annua Linn,	August-September.
Acanthaceae: Hygrophila auriculata (Schum.) Heire.	October-January.
Blepharis maderaspatensis (Linn.) Heyne ex Roth.	October-December.
Petalidium barlerioides(Roth.)Nees. Carvia callosa (Wall.) Bremck	February-April.
Lepidagathis cuspidata(Wall.) Nees	Feb-April.
Eranthemum purpurascens Nees	November-January.
E.roseum (Vahl.) R. Br	November-January. December-February.
B. prionitis Linn	October-January.
B.cristata Linn	September-December.
B.strigosa Willd	
Rungia repens (Linn) Nees	October-January.
Justicia betonica Linn J. quinqueangularis Keen	September-January.
J. simplex D. Don	November-September.
Adhatoda vasica Nees	August-December.
	October-January,
Thunbergia alata Boi	Cultivated,
T. fragrans Roxb T. grandiflora Roxb	
T.laurifolia Lindl	
Thunbergia coccinea Wall	

N	9	m	10
17	а	11	

Flowering season

Verbanaceae: Lantana camara Linn. Stachytarpheta mutabilis Vahl. Tectona grandis Linn. Gmelina arborea Roxb. Premna flavescens Ham. P.barbata Wall. Vitex negundo Linn. V.trifolia Linn. V.leucoxylon Linn. Clerodendron phlomidis Linn. C.serratum (Linn.) Moon. V.viscosum Vent. Holmskloldia sanguinea Retz. Symphorema polyandrum Wight. Duranta repens Linn.	July-September Rainy season. August-September. March-May. March-May. April-June. June-December. June-December. March-August. September-February. August-November. February-May. October-December. February-April
Labiateae: Plectranthus rugosus Wall. Colebrookea oppositifolia Smith Pogostemon plectranthoides Desf.	September-November. December-February. December-February.
Nyctaginaceae: Boerhaavia diffusa Linn B.repanda Willd	October-December.
Amarantaceae: Celosia argentea Linn. Aerua sanguinolenta (Linn.) Bluem. Achyranthes aspera Linn.	September-October. Cold season. November-January.
Chenopodiaceae: Beta vulgaris Linn.	Cultivated.
Polygonaceae (No wild plants): Antigonon leptopus H. and A	Garden plant, August-December.
Lauraceae: Litsea glutinosa (Lour.) Robinson L.monopetala (Roxb.) Pers	June-July. March-May.
Loranthaceae: Viscum articulatum Burm Macrosolen parasiticum Linn. Scurrula parasatica Linn. Dendrophthoe falcata (Linn.) Etting	January-August. October-February, g. February-June.
Santalaceae: Santalum album Linn. Osyris wightiana Wall. ex Wight.	March-April. March-April.
Euphorbiaceae: Euphorbia neriifolia E. nivulia Ham	February-March FebruaryApril August-September

Name			Flowering season
Moraceae:			
Ficus religiosa Linn. F. arnottiana Mig F. lacor Buch. Ham			April—June March—June April—June
E hatamanhadha Limm	• •	••	December—March April—June Throughout the year
F. cunia Ham. F. glomerata Roxb.	• •	· ·	Throughout the year
Artocarpus integra (Thunb	.) Meri	LIII	Cultivated
Salicaceae: Salix tetrasperma Roxb.	-	••	February
Juglandaceae : <i>Juglans regia</i> Linn.	8 + 9		July-September, cultivated
Cupulifereae: Quercus incana Roxb.			August—October, cultivated
	Мопос	otyl	edons
Onshidasaas			
Orchidaceae:			Ameil Man
Geodorum densiflorum Su Oberonia falconeri Hook Microstylis versicolor Lin	dl.		April-May September-October
Vanda parviflora Lindl. V. roxburghii R. Br. Habenaria plantaginea Li	ndl.		April-May July-August March-April
H. hollandiana Satnapau H. grandiflora Lindl.			April-May Monsoon
Zingiberaceae:	स्यमव	পালং	1
Curcuma longa Linn, Zinziber officinale Roxb.	••	••	
Cannaceae: Canna indica Roxb.	••	••	Cultivated
Musaceae: Ensete superbum Roxb.	••		
Bromiliaceae: Ananas comosum (Linn.)	Merr.	••	Cultivated
Agavaceae:			
Agave wightii Drum. A. americana Linn. A. vera cruz Mill.			
Dioscoreaceae:			
Dioscorea anguina Roxb D. oppositifolia Linn. D. bulbifera Linn. A-127-25-B.	•••	• •	September—January September-October August—October

Name Flowering season D. hispida Dennst. July—September D. pentaphylla Linn. D. alata Linn. Cultivated Liliaceae: Smilax zeylanica Linn. July—September Asparagus racemosus Willd. August-November Gloriosa superba Linn. July—October Chlorophytum tuberosum (Roxb.) June Baker. Palmae: Phoenix acaulis Roxb. December-January Phoenix sylvestris (Linn.) Roxb. Casurinaceae Cultivated Casuarina equisetifolia Forst. September-October, cultivated Typhaceae: Typha angustata Bory and Chaub. August Araceae: Arisaema murraya (Grahm.) Hook. June-July Amorphophallus campanulatus Blume. Cyperaceae: Cyperus rotundus Linn. September—November C. corymbosus Roth. September—November Scirpus kysoor Roxb. Bambuseae: Bambusa bambos (Linn.) Voss. ...

After interval of 30 years flowered in 1954 and 1959.

Dendrocalamus strictus Nees.

Apluda mutica Linn. Cultivated

Chionochne koenigii (Spreng.) Thw. Cymbopogon frumantocea Limk. Heteropogon contortus (Linn.)

Beauv.

H. ritchei (Hook.) Blatt.

Panicum miliare Lamk. Paspalum scorbiculatum Linn.

Sehima sulcatum (Rottl.) Stapf.

Sorghum halepense (Linn.) Pers.

8. FLORA OF NAGPUR REGION.

An important region of Vidarbha lies on the other side of Wardha River, mainly concentrated around Nagpur, the former Capital of the Central Provinces and Berar. It is a seat of the University and yet no flora of this place or region has been worked out by any Botanist. Only lists of plants of Telankhedi Farms and around Nagpur are available. They contain about 310 plants and are useful. Recently Balapure (1966) has been describing plants of Nagpur and Ramtek area and Mirashi's (1954—1963) lists of plants around Nagpur are available. Earlier Brandis (1874) and Hooker (1856) had casually mentioned some plants of this area.

Recently Balapure (1966) who has been working on Nagpur, Ramtek, Akola. Jabalpur flora states that there are at least 2000 plants in the old Central Provinces area. Graham's list (1911) is only a fragment of it. Tiwari (1954—56) has also reported a number of grasses in this area, and Mirashi (1954—1959) studied the Water Plants in Nagpur and Umred tanks. All these lists are incomplete, but we have to depend upon them for whatever information we have on the flora of Nagpur region. In 1971 Balapure (1971) described some additional plants from Ramtek, about 45 km north-east of Nagpur. He has particularly drawn attention to the species that appear in the lakes, ponds, river banks and marshy places. He has also described the undergrowth on the wet soil of ponds, and weeds commonly found in the post-monsoon season at Ramtek. Here he describes 130 plants of Ramtek. He also has added some new records for the area.

Nagpur is about 548.6 metres high above the Sea level. lies in the Wardha-Wainganga basin. It is surrounded by small hillocks around. They rise 275.2 metres above. The rainfall is between June and October. It is more than in parts of Western Maharashtra. For example, Pune which has a similar situation gets only 610-685 mm of rain, whereas Nagpur gets 1016-1270 mm of rain. The result is the slopes of hills around Nagpur are well covered by Tectona grandis, Hardwickia binata, Gardenia lucida, G. resinifera and do not look dry. Small hills have a few trees of Anogeissus latifolia, Terminalia paniculata, Flacourtia ramonchi, Diospyros melahoxylon etc. These species shed their leaves completely in the hot season which is prolonged, and has a temperature of 81.50°F. This is in clear contrast with the vegetation at other places in Western Maharashtra. The species here develop mixed deciduous forest. In the summer months grasses and other herhaceous vegetation gets charred and dries up as in Western Maharashtra, and hillocks look barren as in other parts. The cold months from November to February are pretty cold. The temperature reaches a low marks of 3.40°, at the same time the maximum temperature goes up during day time to about 32°C degrees. The light lasts longer in day and nights are pretty cold, since we have moved northwards. No endemics have been recorded so far in Nagpur flora. The soils in the hilly areas are quite shallow, but fertile. Underground water table is deep. Around Nagpur, and from Wardha and beyond, the soils are derived from Deccan traps and are rich black cotton soils. But in Nagpur region towards Amravati, Bhandara and Chandrapur they are sandy loam derived from sand-stones of the Vindhyan origin. As a matter of fact one can see the Vindhyan sandstone overlain by a thin layer of Lametas and they in turn covered by 30-40' thick flows of Deccan trap. This situation is very clear on the well known Hill fort of Sitabardi opposite to the Nagpur Railway Station or at Satnavari on Nagpur-Amravati road and also in wells at various places 16 km to 19 km off Nagpur. The forest mainly consists of dry deciduous species of Tectona grandis, Butea monosperma, Acacia fernasiana, Terminalia arluna, Combretum ovalifolium, Gmelma asiatica, Ficus hispida, Phoenix sylvestris, Bauhinia racemosa, Acacia leucophloea, Acacia catechu, A. pinnata, Carissa congesta Lepidagathis cristata, L. mitis, Lantana camara etc.

The small trees and shrubs here may be mentioned as.—Wrightia tinctoria, Capparis zeylanica, C. horrida, Balanites roxburghii, Zizyphus enoplea, Z. xylopyra, etc. The herbaceous plants are Berleria cristata, Justicia simplex, Boerhaavia diffusa, Amaranthus tricolor, Aerualanata.

Grasses Aristida depressa, Eragrostis punioloides, Themeda quadrivalas, Dicanthium annulatum are common. This kind of vegetation is pretty common and continues some distance towards Bhandara and Wardha; but nowhere in this region one notices evergreen or semi-evergreen forest nitches. Obviously the vegetation is of the mixed deciduous type. This is because the rainfall is more and better distributed during kharif and rabi seasons, and because the soils here are black cotton or the sandy loam highly fertile.

These forests lie very often directly above the trap soils intercalated with intertrappean layers of reddish or greenish soils. Below them are the rich beds of coal. It is being mined at Korhadi near Nagpur, Kamathi, Umred and from mines towards Sausar. Coal is rather of low grade as it contains a large proportion of ash or silica. It is extensively used by the industry around. This coal was first detected on the basis of Glossopteris leaf impressions found at Kamathi by the Rev. Dr. Hislop nearly 150 years ago. He had also noticed a rich Intertrappean flora around Nagpur in the intertrappean beds at Takli hill, Bharatwada and other places. The present day flora of Nagpur is successor to the Gondwana flora capped by intertrappean flora found at several places in Nagpur The best development of the Glossopteris flora in this area is in the Wardha-Godavari Valley. The Intertrappean flora is found around Nagpur, Paradshinga, Sausar, Bor Nala and in the hills near Varoda on Ballharsha road. However the best known intertrappean flora is found in the locality of Mohgaon Kalan, first discovered by Dr. K. P. Rode of Udaipur. We shall consider them in the chapter on fossil flora of Maharashtra.

Bhandara and Gadchiroli districts constitute the eastern boundary of Maharashtra State. Chandrapur and Gadchiroli form a very distinct unit of the flora, though not botanically; because the district Chandrapur is well forested, has more rainfall and higher humidity for about 6-8 months. It is also not having the trap soils but sandy soils which encourage better growth of roots. That is not however the case with the district Bhandara. It has sandy soils or river alluvium in certain parts, and blackcotton soils in other parts. The soils having Deccan traps below encourage flora similar to that in Nagpur. The loamy soils have several plants in addition to those from Western Maharashtra, those from Orissa and Madhya Pradesh districts. However, the common feature of them is the presence of dry deciduous vegetation consisting of Tectona grandis with Adina cordifolia, Terminalia arjuna or T. tomentosa as their associates. These species often grow with Hardwickia binata and Lannea grandis. The last two species suggest dry nature of environment. The presence of Adina cordifolia, abundance of Mangifera indica in places like Patur suggest better conditions of rainfall, but the climate is very h-ot and intolerable for about 4 summer months. It kills many nonwoody species. The flora of Chandrapur will be considered separately, as it is the largest district in size and is very well forested.

It may be mentioned here that Graham's (1911) list has not mentioned many plants belonging to Nymphacaceae, Linaceae, Labiateae, Nyctaginaceae, Alismaceae or grasses later discovered by Mirashi or Balapure, Eriocaulaceae and Cyperaceae. About 100 more species belonging to over 35 families have been added to Nagpur flora by Balapure and Mirashi, but the list is awaiting publication.

WILD PLANTS AT NAGPUR AND TELANKHEDI FARM

(After Graham 1911, Witt 1908 and others)

Name

Flowering period

Menispermaceae

Tinaspora cordifolia Miers ... July-August.

Cocculus villosus DC ... September-November.

Cissampelos pereirae Linn ... September.

Papaveraceae

Argemone mexricana Linn .. All the year.

Cruciferae

Nasturtium indicum DC December.

Gynandropsis pentaphylla DC .. August-October.

Capparis horrida Linn. f April,

Violaceae

Ionidium suffruticosum Ging ... July-September.

Polygaleae

Polygala erioptera DC July-September. Polygala chinensis Linn . . . June-December.

Caryophyllecae

Saponaria vaccaria Linn ... April. Polycarpaea corymbosa Lamk ... August.

Portulacae

Portulaca olerecea Linn . . . July-December.
Portulaca quadrifida Linn . . August-May.

सत्यमव जयत

Malvaceae

Sida humilis Willd August-December.

Sida spinosa Linn . . . July-October.

Sida carpinifolia Linn . . . August-December.

Sida rhombifolia Linn . . . July-January.

Sida rhombifolia Linn ... July-January.
Sida cordifolia Linn ... June-December.

Abutilon indicum G. Don. ... December.

Abutilon graveole is W. and A. . . June.

Malachra cipitata Linn . . . August.

Urena lobata Linn ... October-December.

Urena sinuta Linn ... August-December.

Hibiscus pandurae-formis Burm. August-December.

Hibiscus ficulneous Linn ... August-October.

Hibiscus rugosus Mast ... August-September.

Sterculiaceae

Helicteres isora Linn ... August-September.

Melochia corchorifolia Linn ... August-September.

Flowering period

Name		Flowering period
Tiliaceae		
Grewia salvifolia Heyune		September.
Grewia asiatica Linn		July-March,
Grewia hirsuta Vehl		August.
Triumfetta rhomboidea Jacq		July-September.
Triumfetta rotundifolia Lamk	• •	August-December.
	• •	
Corchorus olitorius Linn	• •	July-December.
Corchorus trilocularis Linn	• •	June-December.
Corchorus fascicularis Lamk		November-December.
Corchorus acutangulus Lamk	• •	August-September.
Malpighiaceae		
Aspidopterys cordata Juss	• •	December.
Zygophylleae		
Tribulus terrestris Linn		September-December.
Geranieceae		
		Iuma Amril
Oxalis corniculata Linn	• •	June-April.
Biophytam sensitivum DC	erous co	July-September.
Impatiens balsamina Linn	30	July-September.
AL SE		Eas
Simarubaceae	344	DAGE!
Balanites roxburghii Planch		December.
No.	uss	57/01
Meliaceae	430e	197
Melia azadirach Linn	176	May.
1.90	1 1	0.1
Rhamnaceae		1100
Ventilago calyculata Tulasna		October-November.
Zizyphus jujuba Lemk	200	April-September.
Zizyphus oenoplia Mill		August-September.
Zizyphus xylopyrus Willd	iler a	July
4404	44	191
Ampelideae		
Vitis repanda W. and	• •	July-August.
var Linnaei Wall.		
Vitis linnaei Wall		June-August.
Vitis latifolia Roxb	• •	July-September.
Vitis setosa Wall		July-August.
77***		July-August.
Vitis carnosa Wall	• •	July-August.
Sapindaceae		
Cardiospermum halicacabum Lis	nn	July-December.
Leguminasse		
Leguminosae		August-December.
Heylandia latebrosa DC	• •	
Crotalaria hirsuta Willd	• •	September.
Crotalaria pumila Heyne		September.
Crotalaria mysorensis Roth	• •	September-December.
Crotalaria linifolia Linn		July-October.
Crotalaria calycina Schrant	٠.	July-September.
Crotalaria retusa Linn		August-November.
Crotalaria orixensis Rottl		August-November.
Melitotus parviflora Desu	• • •	January-March.
Melilotus alba Lamk	• •	January-March.
Indigofera linifolia Restz	• •	June-December.
maigojera unijona Restz	• •	anic-December.

Name Flowering period

Indigofera linifolia var. campbelii June. Wight. *Indigofera cordifolia* Heyne August-November. Indigofera glandulosa Willd September-December. Indigofera anneaphylla Linn June-December. Indigofera trifoliata Linn September-December. *Indigofera trita* Linn September-November. Indigofera hirsuta Linn September-January. *Psoralea corylifolia* Linn ... September-October. Tephrosia purpurea Pers ... July-December. Tephrosia villosa Pers ... August-November. Sesbania aculeata Pers September-December. Zornia diphvlla Pers August. . . Smithia geminiflora Roth... November-December. Aeschynomene Indica Linn July-September. Pseudarthria viscida W. and A September. Uraria picta Desu ... July-September. Uraria lagopoides DC August-September. Alysicarpus monilifer DC July-December. October. Alysicarpus vaginalis DC Alysicarpus bupleurifolius Alysicarpus rugosus DC var. hey-October-November. neanus Baker. .. October-December. Alysicarpus rugosus DC var. styracifolia Baker. Alysicarpus tetragonolobus Edgw July-December. Desmodium taxiflorum DC October. Desmodium gangeticum DC August-December. **Desmodium** diffusum DC October. ... Desmodium triflorum DC June-December. .. August. Abrus precatorius Linn Teramnus labialis Spreng ... August-September. .. October-December. Mucuna pruriens DC Erythrina indica Lamk. Butea frondosa Roxb March. Canavalia ensiformis DC ... ٠. Phaseolus trilobus Ait August-October. Phaseolus aconitifolius Jacq August-December. Phaseolus trinervius Heyne August-November. Clitoria ternatea Linn August. Clitoria ternatea var, pilosalaz Baker. September-December. Atvlosia scarobaeoides Benth September. Atylosia platycarpa Benth . . June-December. Rhynchosia minima DC Caesalpinia bonducella Flemming September-October. Parkinsonia aculeata Linn March-April. Cassia occidentalis Linn ... July-January. August-October. Cassia tora Linn ... Cassia obtusifolia Linn ... August-October. Cassia absus Linn .. July-September. August-November. Cassia pumila Lamk . . Cassia mimosoides Linn ... August-November. July-August. Neptunia triquetra Benth August-January. Dichrostachya cinerea W. and A

Name		Flowering period
Leucaena glauca Benth	-10	August-April.
Mimosa hamata Willd		June-September.
Acacia farnesiana Willd	• •	December-January.
Acacia arabica Willd	• •	August-December.
Acacia leucophlaed Willd Acacia catechu Willd	• •	August-September.
Acacia pennata Wild	••	August-September, June.
Pithecolobuim dulce Benth	••	April.
Combretaceae		
Terminalia arjuna Bedd	• 20	May.
Combretum ovalifolium Roxb	• 1 •	February-March.
Quisqualis indica Linn	• •	•
Lythraceae		March—June.
Ammannia pentandra Roxb	• •	December.
Ammannia baccifera Linn	•.•	December.
Ammania salicifolia Manth.	••	October-December.
Woodfordia floribunda Salisb Lawsonia alba Lamk	••	January-March. June.
Lawsonia aloa Lanik	30	June.
Onagraceae		1643
Ludwigia parviflora Roxb		July-August.
D 10	18	3290
Passifloreae		407
Passiflora foetida Linn Trichosanthes cucumerina Ling	***	July-August.
Trichosamnes cacamerina Linu	3 5	July-September.
Cactaceae		128.25
Momordia dioeca Roxb	•••	July-September.
Momordica cymbalaria Eng.		August.
Cephalandra indica Naud	••	market I
Cucumis trigonus Roxb	•••	July-January.
Mukia scabrella Arn	• •	September-October. July-October.
Zehneria umbellata Thw		August-September.
0		and a coprement.
Oocteae Opuntia dillenii How	_	July-October.
CP		
Ficoideae		_
Trianthenia monogyna Linn	•••	January.
Mollugo hirta Thunb	•••	December-April.
Mollugo stricta Linn	•-	July-December.
Rubiaceae		
Oldenlandia corymbosa Linn	• ••	August-December.
Anotis montholini Hook	***	August.
Knoxia corymbosa Willd	***	July-October.
Spermacoce stricta Linn	• •	August-September.
Spermacoce hispida Linn	•••	July-November.
Compositae		
Vernonia vinerea Less		January-March.
Ageratum conyzoides Linn	***	June-August.
Cythocline gyrata Cass	• •	October-January.
		•

Name		Flowering period
Grangea maderaspatana Poir		January-April.
Sphaeranthus indicus Linn	• •	December-April.
Gnaphalium luteo-album Linn	• •	December-April.
Caesulia axillaris Roxb	• •	October-December. July-December.
Vicoa auriculata Cass Pulicaria angustifolia DC	• •	August-January.
Lagascea mollis Cav	• •	July-October.
Xanthium strumarium Linn		November-December.
Euipta alba Hassk		July-December.
Blainvillea latifolia DC		August-December.
Spilanthes acemella Linn		July-December.
Glossocardia linearifolia Cass	• •	July-November.
Bidens pilosa Linn	• •	July-August.
Glossogyne pinnatifida DC	• •	July-September. July-October.
Tridex procumbens Linn	• •	June-January.
Flaveria contrayers Pers Echinops echinatus DC		October-May.
Coniocaulon glabrum Cass		July-July.
Voluturella divaricata Benth		August-November.
Sonchus arvensis Linn	à	September-January.
Launaea nudicaulis Cass	Also.	April.
	163	53
Plumbagineae Plumbago zeylanica Linn		July-December.
Apocynaceae	79	7
Carissa carandas Linn	4.0	March.
Vinca pusilla Merr	D.	August-September.
Asclepiadeae	NIS.	**\
Hemidesmus indicus Br	1	August.
Cryptolepis buchanani Roem		May-July.
Oxystelma esculentum Br.	नगर	August.
Cryptostegia grandifolia Br.	• •	July-November.
Calotropis gigantea Br	• •	June-February.
Daemid extensa Br	• •	August-December. August.
Holostemma rheedei Wall	• •	August.
Dregea volubilis Benth Leptadenia reticulata W. and A.	• •	July.
Leptaniana rentaliana W. and M.	٠.	, v , .
Gentianaceae		0 4 han D
Exacuni pedunculatum Linn	• •	October-December.
Hoppea dichotoma Willd	••	November-December.
Enicostema littorale Blume	•••	June. February-April.
Erythraea roxburghii D. Don Canscora decurrens Dalz	• •	October-February.
Canscora aecurrens Daiz	• •	0000001 1 001 1111 170
Boraginaceae	-	
Heliotropium ovalifolium Forsk	• • •	May-July.
Heliotropium paniculatum Br.	• •	August-September.
Trichoclesma indicum Br	• •	August-September. June-December.
Trichodesma indicum Br.	• •	June-December.
Trichoclesma amplexicule Both	• •	Juile-Leccinoci.
Convolvulaceae		
Rivea hypocrateriformis Chois		August-September.
Argyreia sericea Dalz	• •	August-September.
 -		

Flowering period

October-November. Ipomoea coccinea Linn September. Inomoea auamoclit Linn ... September-October. Ipomoea pes-tigridis Linn September-December. Ipomoea eriocarpa Br. October-April. Ipomoea reniformis Chois July-September. Ipomoea obscura Ker August-January. Convolvulus arvensis Linn... . . Convolvulus parviflorus Vahl September-November. July-April. Evolvulus alsinoides Linn

Solanaceae

Solanum nigrum Linn ... Solanum xanthocarpum Schrad and Wendl.

Physalis minima Linn
Withania somnifera Dunal
Datura fastuosa Linn
Datura fastuosa var alba Clarke

August-December.
Throughout the year.

June-October. September. September. October.

Scrophularineae

Sopubia delphinifolia G. Don

Celsia coromandeliana Vahl.

October-April.
July-December.

.. July.
.. August.
.. August.
.. July-September.

July-September.
August-November.

November.

July-January.

April.

August-September.

October-December.

Pedalineae

Martynia diandra Glox ...
Hygrophila spinosa T, And.
Calophanes nagchana Nees
Ruellia prostrata Lamk ...
Ruellia patula Jacq. ...
Blepharis boerhaviae folia Pers

Peristrophe bicalyculata Nees

Ruellia patula Jacq. ... June.

Blepharis boerhaviae folia Pers ... July-December.

Barleria prionitis Linn ... October.

Barleria cristata Linn . . . September.

Andrographis echiodes Nees . . August-December.

Lepidagathis cristata Willd . . September-November.

Lepidagathis cristata Willd ... September-November L. mitis Dalz. ... October.

Justicia quinquangularis Koen June-October.

Justicia diffusa Willd ... June-December.

Rungia elegans Dalz. ... October-December.

Verbenaceae

Lantana camara Linn ... August-October.
Lippia nodiflora Rich ... May-December.
Stachytarpheta indica Vahl. July-September.
Gmelina asiatica Linn ... April-August.
Clerodendron serratum Spreng ... August.

Labiatae

Ocimum canum Sims ... July-December.
Ocimum basillicum Linn. ... July-April.

Name		Flowering period
Orthosiphon pallidus Royle		August-September,
Plectranthus incanus Link.	• •	September-December.
Anisomeles ovata Br	• •	October-December.
Laucas cephalotes Spreng	• •	July-September.
Laucas urticaefolia Br Laucas aspera Spreng	• •	August-December. August-December.
Leonotis nepetaefolla Br.	• • •	November-December.
- •		Trovenior Bedomoci.
Nyctagineae		
Mirabilis jalapa Linn Boerhaavia repens Linn.	• •	Throughout the year.
Doernaavia repens Liini.	••	rmoughout the year.
Amaranthaceae		
Celosia argentea Linn	• •	September-November.
Digera arvensis Forsk	• •	August-December,
Amaranthus spinosus Linn. Amaranthus blitum Linn.	••	July-April. July-January.
Pupalia lappacea Moq	••	September-December.
Aerua lanata Juss		July-December.
Achyranthes aspera Linn.	• •	July-October.
Alternanthera sessilis Br.	3). <u> </u>	14
Chenopodiaceae	ME.	ÉR.
Chenopodium album Linn.		January.
Basella rubra Linn		October-December.
Polygonaceae Polygonum plebejum Br.		July-April.
Aristolochiaceae Aristolochia bracteata Retz		September.
Laurineae		
Cassytha fitiformis Linn.:	***	August-September.
4444	পাপ্র	
Euphorbiaceae Euphorbia cristata Heyne		September.
Euphorbia hypericifolia Linn.	• •	August-January.
Euphorbia pilulifera Linn.		Throughout the year.
Euphorbia rosea Retz	• •	June-August.
Euphorbia thymifolia Burm.		Throughout the year.
Euphorbia dracunculoides Lam		December-January. December
Euphorbia rothiana Spreng E. geniculata Orteg	••	July-October.
Phyllanthus reticulatus Poir.	• •	July-December.
P. maderaspatensis Linn.	••	July-January.
P. simplex Retz		July-November.
P. niruri Linn.	• •	July-August.
Fleuggia microcarpa Blume F. leucopyrus Willd	• •	July-August.
Jatropha gossypifolia Linn.	• •	May-August. May-August.
Jatropha curcas Linn	••	May-August.
Chrozophora plicata A. Jass.		October.
C. prostrata Dalz	• •	May-July.
Acalypha malabarica Muell.	• •	June-October.
Acalypha ciliata Forsk Baliospermum axillare Blume	•••	July-August. May-October.
Tragia involucrata Linn.	• •	July-December.
	-	•

FLORA OF VIDARBHA		
Name	Flowering period	
Urticaceae Ficus religiosa Linn. F. hispida Linn. F. glomerata Roxb. Fleurya interrupta Gaud.	September August August August.	
Orchideae <i>Habenaria marginata</i> Coleb.	August-September.	
Amaryllideae Curcuago orchioides Gaertn.	July.	
Dioscoreaceae Dioscorea bulbifera Linn.	July-September.	
Liliaceae Asparagus racemosus Willd. Gloriosa superba Linn	October-December August-September.	
Commelinaceae Commelina bengalensis Linn, Aneilema nudiflorum Br. Cyanotis cristata Schult, f. C. axillaris Roem and Sch,	August-September August-September August-September July-August.	
Palmeae Phoenix sylvestris Roxb	March-April.	
Typhaceae Typha angustata Chaub and B	ory April.	
	(8-(2)	
	AMTEK [After Balapure (1971)]	
Name	Locality	
Nymphaeaceae: Nymphaea nauchali Burm f. (N. pubescens Willd.)	•	
Capparidaceae: Capparis zeylanica Linn.		
Malvaceae: Hibiscus cannabinus Linn. H. lobatus (Murr.) O. Kze Sida spinonsa Linn. Pavonia zeylanica Cav.	Nagarjun hill Ramtek Forest D	ivision.

Tiliaceae:

Corchorus fascicularis Lam.

Linaceae:

Linum usitatissimum Linn.

Malpighiaceae:
Aspidopterys wallichii Hook, f.
Anacardiaceae:
Mangifera indica Linn.

Locality

Papilionaceae:

Crotolaria albida Heyne ex Roth Ramtek Forest Division. Indigofera linifolia Retz.

I. trita Linn, f

I. glandulosa Willd.

Alysicarpus rugosum DC var.styracifolius Baker.

A. hamosus Edgew Nagarjun hill.

Dolichos lablab Linn.

Smithia sensitiva Ait. ... Do.

Phaseolus trilobus Ait.

Desmodium diffusum DC.

Cicer arietinum Linn.

Rhynchosia bracteata Benth Do.

Sesbania bispinosa (Jacg) W. F. Wight.

S. aculeata Pers.

Lathyrus sativus Linn.

Clitoria ternatea Linn.

Caesalpiniaceae:

Bauhinia racemosa Lamk. Acacia farnesiana Willd. A. niliotica (L.) Del.

-(A. arabica Willd.)

A. leucophleoa Willd

Trapaceae:

Trapa natans Linn. var bispinosa (Roxb) Makino

Onagraceae:

सत्यम् व जयत Jussiaea linifolia Wall. Ramtek Forest Division. J. repens Linn.

Cucurbitcaceae:

Cucumis trigonus Roxb.

Melothriamaderaspatana (L) Nagarjun hill.

Cong.

Rubiaceae:

Oldelandia corymbosa Linn.

Compositae:

Ageratum conyzoides Linn. Grangea maderaspatana Poir. Goniocaulon glabrumeass Vernonia cinerea Less. Volutarella racemosa (Roxb)

Santapau.

(V. divaricata Benth, and Hook.)

Plumbaginaceae:

Plumbago zeylanica Linn. On way to Surriver.

Locality Name Ebenaceae: Common in forest. Diospyros melanoxylon Roxb. Apocynaceae: Ichnocarpus frutescens Br. Wrightia tinctoria R. Br. Loganiaceae: Strychnos potatorum Linn. Gentianaceae: Nymphoides cristatum (Roxb) O. Kuntze. (= Limnanthemum indicum Griseb.). Exacum pedunculatum Linn, Enicostemma littorale Blume Boraginaceae: Heliotropium ovalifolium Forsk Trichodesma zeylanicum R. Br. Convolvulaceae: Ipomoea aguatica Forsk Î. hispida (Valil.) R. and S. Scrophulariaceae: Nagarjun hill. Lindernia ciliata (Colsm.) Pennell. (= Bonaya brachiata Link and Otto). Yeronica anaagallis Linn. Nagarjun hill. Striga euphrasioides Benth. Stemodia viscosa Roxb सत्यमव जयत Lantibulariocea: Utricularia flexuos Vahl. Acanthaceae: T. Hygrophila polysperma Anders. purpurascens Nagarjun hill. Daedalacanthus T. Anders. Nagariun hill. Barleria cristata Linn. ... Forest near Khindsi tank. Rungia parviflora Nees ... Labiatae: Ramtek forest. Hyptis suaveolens Poir. Nyctaginaceae: Nagarjun hill. Boerhcevia diffusa Linn. Amaranthaceae: Amaranthus tricolor Linn.

Aerua lanata Juss.

Nothosaerva brachiata L.
Digera muric. 1a (Linn.) Mart.

Nagarjun hill.

Ramtek forest

Name Locality Polygonaceae: Polygonum hydropiper Linn. ... Nagarjun hill. Euphorbiaceae: Euphorbia hirta Linn. Ramtek Forest. E. perbracteata Gage Phyllanthusmaderaspatensis Iragia cannabira Linn. f. Urticaceae: Ficus tomentosa Roxb. Commelinaceae: Commelina hasskarllii B, Cl. ... Sur river. Cyanotisaxillaris (Linn.) Schuttz. f. Nagarjun hill. Alismaceae: Sagittaria sagittifolia Linn. Butomopsis lanceolata Kunth Eriocaulaceae: Eriocaulon quinquangulare Linn. Nagarjun hill. Cyperaceae: Bulbostylis barbata Kunth Nagarjun hill. Eleocharis atropurpurea Kunth Cyperus sanguinolentus Vahl. .. Sur river. C. pumilus Nees.. Nagarjun hill. C. iria Linn. Sur river. Sur river. C. fiffusus Roxb. C. eleusinoides Kunth Nagariun hill. C. flavidus Actz. Sur river. Scirpus supinus Linn. S. kernii Raymond Amba tank. Fimbristylis schoenoides Vahl. Nagarjun hill. F. tetragona R. Br. Nagarjun hill. Fimbristylis monostachya Hassk. Sur river. F. diphylla Vahl. Nagarjun hill. Rhynchospora longisetis R. Br. Nagarjun hill. Gramineae: Aristida depressa Retz ... Ramtek forest. Brachiaria eruciformis Griseb Elytrophorus spicatus (Willd.) Near ponds. Eragrostis unioliodes Nees Nagarjun hill. E. diarrhena Steud E. gangetica Steud E. tenella R. and S. Ischaemum rugosum Salisb. I. molle Hook. f. I. seilema laxum Hack.

Oryzasativa Linn.

Lecality

Sorghum bicolor Moench. Ramtek.
Themeda quadrivalvis O. Kunz.
Rottboellia Sp.
Dichanthium caricosum A.
Camus
D. annualatum Stap. f.
Vetiveria zizahinoides (Linn.)
Nash.

9. FLORA OF CHANDRAPUR 1:

The district Chandrapur is situated between 78°-48' to 80°-55' East longitude and 18°-41' to 20°-50' North latitude. The greater part of it consists of undulating hill ranges 150 m-450 m above M. S. L. The surrounding plain is cut across by several Nallas and small streams. The river Vainganga passes through the middle of the district touching Vadasa, Armori and Aheri and is joined by river Dina. Together they form Pranahita river which joins Godavari river at Sironcha in Maharashtra. District Bastar of Madhya Pradesh lies to its East and the District Adilabad of Andhra Pradesh lies on its south. The climate is very hot in summer but has well distributed rainfall throughout the District. July is the heaviest rainfall month. Cold season is from Dmecember to February followed by hot season up to June. The monsoon lasts from June to September. October, November form postmonsoon period. Weather storms from the Bay of Bengal cross the district and keep the area humid up to February. The soils are sandy loam derived from granitaees and quartz alluviam of rivers like Pranahita Vainganga. The tops of hills are denuded and have shallow soils. On the lower slopes of hills it is deep and extremely good for the growth of forest trees on the ridges, and in valleys. The flora of this place is Some plants in this district have been mentioned not much known. by Haines (1916) Tiwari (1954-55),—(1963), Tiwari and Maheshwari (1964). However Malhotra and Moorthy (1971), (1973) have given a a fuller account of the flora of the district with localities. Their list contains 780 species spread over 463 genera and 110 families spread over various localities.

The perusal of this list shows that the following are the predominant families.—

	Family				Genera	Species
1.	Fabaceae (Papilionaceae)				82	72
2.	Poaceae (Gramineae)				30	71
3.	Cyperaceae		• •	••	11	37
4.	Asteraceae (Compositeae)		• •	••	27	35
5.	Acanthaceae		• •		20	28
6.	Malvaceae		• •		9	25
7.	Rubiaceae		••	• •	16	25
8.	Convolvulaceae		• •	• •	8	25
9	Caesalpinaceae		• •		9	19
10.	Amarantaceae				11	17
11.	Mimoseae	••	• •	••	8	15

This account pertains to Chandrapur and Gadchiroli Districts, A-127—26-A.

It is quite obvious from this, that a large number of herbaceous members are found side by side with tree species like Tectona grandis, Mitragyna parvifolia, Albizzia lebbeck, Anogeissus latifolia, Bombax ceiba, Adina cordifolia, Bridelia retusa, Chloroxylon swietenia, Dalbergia lanceolaria, Stereospermum suaveolens, Soymida febrifuga. Compared to herbaceous plants, the woody species are few. These woody species form tall canopy. The tree growth of Tectona and other tree species here is so good that they hardly indicate the deciduous nature of the forest here. The second layer of plants in the forest is formed by Adina cordifolia, Butea monosperma, Capparis grandis; Clerodendron serratum, Cleistanthus collinus, Eriolaena hookeri, Erithroxylon monogynum, Gardenia gummifera, G. resinifera, Garuga pinnata, Helicteris isora, Holarrhena antidysenterica, Leea edgeworthii, Pavetta indica, Woodfordia fruticosa, Latana camara is widely spread in open and waste lands. A number of lianas and climbers of Abrus precatorius, Ampelocissus latifolia, Aristolochia indica, grow abundantly with Atylosia scabraesoides, Dioscorea pentaphylla, Hemidesmus indicus, Ichnocarpus frutescens, Mucuna prurita, Ventilago denticulata etc.

Due to heavy rainfall and humidity the trees are loaded with epiphytic orchids like Vanda tessellata and parasites like Cassytha filiformis, Dendrophthoe falcata, Viscum articulatum etc. Bamboos and pricky thickets of Calamus are plentiful,

The undergrowth consists of Abutilon indicum, Acalypha indica, Achyranthus aspera, Ageratum conyzoides, Andrographis puniculata. Blumea membranacea, Desmodium gangeticum, Cyanotis cristata, Cyperus species like C. rotundus, Dactylectinium aegypticum, Orthosiphon pallidus, Osbeckia zeylanicum, Rhynchosia sures, Yernonia cinerea, Xanthium sturmarium, Zornia gibbosa etc.

On the countryside in open trees and shrubs of Ailanthus excelsa, Bauhinia variegata, Azadirachta indica, Calotropis gigantea, Capparis zeylanica, Cassia auriculala, Casuarina equisitifolia, Delonix regia, Derris indica, Hibiscus lampas, Emblica oficinalis, Ficus engbenghalensis F. religiosa, Mangifera indica are cultivated.

The district has a large number of ponds, small and large, and the intersecting nallas, and rivers. Aquatic plants Ceratophyllum demersum Nelumbium nucifera, Nymphaea nouchali, N. stellata Pistia stratiotes, Aeschanomene aspera, Dentella repens are quite common. Besides these one finds herbaceous plants of Eriocaulon dianae, E. truncatum, Paspalum vaginatum, Rotala indica, Zyris pauciflora in marshy areas.

It will be seen from this that the flora here is like the flora in the valleys of western Maharashtra. But the growth of trees is much better here than there due to humidity for the most part of the year and good soil.

The timber trees like Tectona grandis, Stephegyne parvifolia, Adina coridifolia here grow very best in the whole of India. Analysis of both herbaceous and woody species however indicates the dry deciduous nature of the flora and vegetation. Besides species from Orissa and Andhra Pradesh also grow therein. In Bastar Tectona grandis and Shorea robusta are found together, but not here. The famous 'Alapalli' forest is a few km. from Chandrapur and has the tallest and largest timber trees of Tectona grandis. It reaches here nearly 120' height, more than double that at other places.

The Alapalli teak is much valued for its size and figured wood good for veneering. Ordinary teak fetches very high price for furniture and building timber.

The Chandrapur district is populated by Raj Gonds and the Media Gonds. They are a fascinating Girijan community, but extremely poor. Co-operative Societies are formed for them for selling myrobalans (Terminalia chebula) and Tendu or bidi leaves (Diospyros melanoxylon) and such other minor forest products. Cultivation of medicinal plants is being encouraged for their benefit e. g. pink Vinca, V. rosea. Its roots and leaves contain anticancerous substance, Vinblastin. There is shifting cultivation in the forest here called Kumri cultivation. It plays havoc with young plants and saplings and their buds.

It will be seen that the flora of Chandrapur is very rich in having an assemblage of dry deciduous and semi-evergreen or moist deciduous species; but that alone is not its special feature. The special feature is the luxuriant growth of teak (Tectona grandis) and other species.

FOREST RESERVE OF ALAPALLI:

A patch of forest rightly called "Glorv of Alapalli" is kept reserved as a show piece, a permanent preservation plot since, 1963. Shooting is not allowed here. It is situated 14 km. away from Alapalli on Pranahita river. The average rainfall here is 1525—1780 mm. mostly from July to October. Summer temperature is very high 118°. The climate is extremely humid as a number of nallas cross it, soil being mostly alluvial or sandy. The trees develop admirably good root system in loose sandy soil. The growth of teak and other species here is the best in India as good as that of teak in Burma or Malabar.

The trees are the same as we have seen in Melghat and in the other ghat section of Maharashtra on the Desh side, but they are undisturbed. Such virgin forest must have been quite common in the past all over the peninsular India. Even in the valley of Narmada today, it is not so rich or semi-evergreen as this, but perhaps it was so in the past.

SELECTED LIST OF PLANTS FROM THE FLORA OF CHANDRAPUR DISTRICT [After Malhotra and Moorthy (1971)]

Name

Locality

Dilleniaceae

Dillenia aurea Smith

.. Koppela, 108036 A.

Menispermaceae

Cissampelos pariera Linn.

Kistapur, 117181;

Nymphaeaceae

Nymphaea nouchali Burm.

Dechali.

N. stellata Willd. . . . Dechali,

Nelumbonaceae

Nelumbo nucifera Gaertn. .. Mesa.

Brassicaceae

Rorippa indica (Linn.) Hiern ... Ashti.

Cleomaceae

Cleome monophylla Linn. .. Kukdel,

Name	Locality
Capparidaceae	
Capparis grandis Linn. f.	Mesa.
C. sepiaria Linn	Mesa.
1 —	
Violaceae	
,	Daine
Hybanthus enneaspermus (Linn.)	Kajura.
F. Muell.	
Flacourtiaceae	
Flacourtia indica Merr. (Burm. f.)	Vadasa.
•	
Polygalaceae	
Polygala chinensis Linn	Lakkadkot,
n [, 171]	Park 1 1
n	
P. erioptera DC.	
Salomonia oblongifolia DC	Brahmapuri.
Tamaricaceae	
Tamarix ericoides Rottl	Chaudampalli nala.
estato.	-
Elatinaceae	^
Bergia ammannoides Roxb	Chandrapur.
ex Roth.	Chandraput.
On Keen,	
Malvaceae	96
Abelmoschus esculentus (Linn.)	Chandrapur (cultivated).
Moench.	4
Hibiscus lampas Cav	Elgurtola. Dechali.
Hibiscus labatus (J. A. Murray)	Dechali.
O' Kize.	74%
Hibiscus panduraeformis Burm	Markanda.
Kydia calycina Roxb	Jimalagatta.
Malachra capitata (Linn') Linn.	
Sida mysorensis Wt and Arn	Tamurda
Sida mysorensis Wt. and Arn	Chantack and:
Urena lobata Linn	Ghantachowki.
Dandasassas	
Bombacaceae	
Bombax ceiba Linn	Lakkadkot.
Sterculiaceae:	
Byttneria herbacea Roxb	Bamni (Sironcha).
Eriolaena hookeriana Wt. and Arn.	Alapalli,
Sterculia urens Roxb	Tadoba,
	144004,
Tiliaceae	
Grewia abutilifolia Vent. ex Juss.	Markanda.
G. hirsuta Vahl,	Ghantachowki.
G. rothii DC.	Koppela.
G. serrulata DC	Wamanpalli,
G. tiliaefolia Vahl	Brahmapuri.
Trees, ores twill to	zammapun,
Malpighiaceae	
Aspidopteris cordata	Brahmapuri.
•	
Oxalidaceae	T
Biophytum reinwardtii Edgew. ex	Jamni (Tadoba).
Hook f.	

Locality

Name

Balsaminaceae Impatiens balsamina Linn	Nagbhir.
Rutaceae Aegle marmelos Cotr Citrus aurantifolia (Chirst.) Swingle.	Kanhargaon. Kukdel.
Simarubaceae Ailanthus excelsa Roxb. Balanites aegyptiaca (Linn.) Delile.	Kanhargaon Kanhargaon.
Burseraceae Boswellia serrata Roxb Garuga pinnata Roxb	Manekshahgadh. Rajura.
Meliaceae Soymida febrifuga A. Juss	Sondo (Rajura).
Olacaeceae Olax scandens Roxb. Cassine glauca (Rottb.) O. Kuntz. Celastrus paniculata Willd. Meytenus emarginata (Willd.) Ding How.	Rajura. Ghodejhari (Nagbhir) Elgurtola. Lakkadkot.
Rhamnaceae Ventilago denticulata Willd Zizyphus mauitiana Lamk, Z. oenoplia Mill Z. rugosa Lamk Z. xylopyra Willd	Dechali. Repanpalli. Ghantachowki. Kotagul. Rajura.
Vitaceae Cayratia trifolia (Linn.) Domin Vitis linnaei Wall	Mesa. Chandrapur.
Leeaceae Leea edgeworthii Sant	Pimpalkhuta (Kolsa). Junona. Somanpalli.
Sapindaceae Schleichera oleosa (Lour.) Oken	Keslaghat.
Anacardiaceae Buchanania lanzan Spreng. Lannea coromandelica (Houtt.) Merr. Semecarpus anacardium Linn. f.	Rajura. Brahmapuri. Manekshahgadh.
Moringaceae Moringa concanensis Nimmo M. oleifera Lamk	Lakkadkot. Murumgaon.

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Name	Locality
Fabaceae	
Aeschynomene aspera Linn	Naleshwar.
A. indica Linn	Ghantachowki.
Alysicarpus monilifer (Linn.) DC.	Lakkadkot.
Atylosia platycarpa Linn	Khatoda (Tadoba).
A. scarabaeoides (Linn.) Benth.	Ghantachowki.
Butea monosperma (Lamk). Taub.	Manekshahgadh.
Canavalia ensiformis DC	Bamni (Sironcha)
Clitoria orixensis Willd	Chandur.
Dalbergia lanceolaria Linn. f	Pangri (Kolsa).
D. latifolia Roxb	Manekshahgadh.
D. sissoo Roxb	Ballarpur.
Derris indica (Lamk).) Bennet	Kotagul (Bergaon).
D. scandens (Roxb.) Benth	Wamanpalli.
Desmodium gangeticum (Linn.)DC	Dechali.
D. heterocarpon (Linn.) DC	Elchil ¹
Eleiotis monophylla (Burm. f.) DC	Elgurtola.
Indigofera tinctoria Linn	Alapalli.
Moghania strobilifera St. Hil ex	Kurkheda.
Jacks.	
Mucuna prurita Hook	Lakk adkot.
Pseudarthria viscida Wt. and Arn.	Somanpalli.
Psoralea corylifolia Linn	Markanda.
Pterocarpus marsupium Roxb	Wirur.
Rhynchosia aurea DC	Khatoda (Tadoba).
Sesbania bispinosa (Jacq.)	Ghantachowki.
Fawcett et Rondle.	
Smithia confera Sm	Nagbhir.
Tephrosia hirta Buch. Ham	Wamanpalli.
T. purpurea Pers	Ghantachowki.
T. strigosa (Dalz.) Sant. and Mahesh.	Katejhari (Tadoba)
Vigna radiata (Linn.) Wilczok	Chandrapur.
V. triloba (Linn.) Verde	Warora.
•	
Caesalpiniaceae	
Bauhinia purpurea Linn	Rajura.
B. racemosa Lamk	Lakkadkot.
B. variegata Linn	Dechali.
Caesalpinia pulcherrima (Linn.)	Sironcha.
Sw.	
Cassia absus Linn	Rajura.
C. fistula Linn	Kanhargaon.
C. pumila Lamk.	Tamurda.
Piliostigma malabaricum Benth.	Choaudmpalli.
Mimosaceae	
Acacia chundra (Roxb.) Willd	Asaralli.
A. leucophloea Willd	Lakkadkot.
A. nilotica (Linn.) Del. subsp.	Ashti.
indica (Benth.) Brenan.	
Albizzia lebbek (Linn.) Benth	Lakkadkot.
Mimosa hamata Willd	Lakkadkot.
	> 0 m 0 m m n l l l

Somanpalli.

.. Chandrapur (planted). .. Garlapeth (Wirur).

M. rubicaulis Lamk.

Xylia xylocarpa Taub.

Samanea saman (Jack.) Merr.

Locality Name Saxifragaceae .. Ashti. Vahlia digyna (Roxb.) O. Kuntze. Droseraceae Drosera burmanni Vahl Keslaghat. Haloragaceae Myriophyllum spathulatum Tadoba. Blatt. and Hallb. Combretaceae Manekshahgadh. Anogeissus latifolia (Roxb.) ex DC. Bedd. Calycopteris floribunda (Roxb.) ... Maseli (Bergaon). Lamk. Kurkheda. Combretum decandrum Roxb. Keslaghat. C. ovalifolium Roxb. Garlapeth (Wirur). Terminalia arjuna (Roxb. ex DC) Wt. and Arn. Tamurda. T. bellerica (Gaertn.) Roxb. Rajura. T. chebula Retz. .. Pandarpani (Tadoba). T. crenulata Roth ... T. tomentosa Wt. and Arn. Lakkadkot. Myrtaceae Syzygium cumini (Linn.) Skeels ... Dechali. Keslaghat. S. heyneanum Wall. Barringtoniaceae Barringtonia acutangula (Linn.) . . Aheri. Gaertn. Lecythidaceae Katejhari (Tadoba). Careya arborea Roxb. सत्यमेव जयते Melastomaceae Bamni (Sironcha) Melastoma malabathricum Linn. Memecylon umbellatum Burm. 🕳 Dechali. Lythraceae Lagerstroemia parviflora Roxb. Sironcha. Rotala indica (Willd.) Kochne ... Dechali. Woodfordia fruticosa (Linn.) Kurz. Lakkadkot. Oangraceae Ludwigia hyssopifolia (G.Don) ... Somanpalli. Exell. Bamni (Sironcha). L. octovalis (Jacq.) Raven subsp. sessilifora. Tamurda. L. perennis Linn. ... Samydaceae Keslaghat. Casearia elliptica Willd. Armori. C. graveolens Dalz. Caricaceae Carica melo Linn. var. agrestis .. Nagbhir. Mukia maderaspatana (Linn.) .. Ghantachowki.

Roem.

Name	Locality
Molluginaceae	
Glinus lotoides Linn	Ashti.
G. oppositifolius (Linn.) A. DC.	Junona.
Mollugo nudicaulis Lamk	Rajura.
Alangiaceae Alangium salvifolium (Linn. f.) — Wang.	Armori.
Rubiaceae Adina cordifolia (Roxb.) Hook. f.	Somanpalli.
ex Brandis. Borreria articularis (Linn. f.)	Ghantachowki.
F. N. Will. B. pusilla (Wall.) DC	Mesa.
Canthium parviflorum Lamk	Mesa.
Dentella repens (Linn.) J. R. and G. Forst.	Kukdel (Bergaon).
Gardenia gummifera Linn	Kanhargaon.
G. latifolia Ait	Lakkadkot.
G. resinifera Roth	Rajura.
G. turgida Roxb	Rajura.
Hydyotis caerulea Wt and Arn.:	Pambhurna,
H. nudicaulis Wt. and Arn	Bamni (Sironcha).
H. umbellata Lamk.	Bamni (Sironcha).
Ixora arborea Roxb. ex Sm	Dechali.
Knoxia sumatrensis (Retz.) Korth.	Dechali.
Mitragyna parvifolia (Roxb.) Korth.	Ghantachowki.
Pavetta indica Linn	Markanda.
Xeromphis spinosa (Thunb), Keay	Rajura.
X. uliginosa (Retz.) Mahesh Asteraceae	Brahmapuri.
Acanthospermum hispidum DC	Ghantachowki.
B. obliqua (Linn.) Druce	Kanhargaon.
Echinops echinatus Roxb	Chandur.
Claubantania angkau Timo	Bamni (Sironcha).
Grangea maderaspatana (Linn.)	Kukdel.
Poir.	
Parthenium hysterophorus Linn	Chandrapur.
Vernonia anthelmintica Willd	Junona (Chandrapur).
Xanthium strumarium Linn	Ghantachowki.
Lobeliaceae: Lobelia alsinoides Lamk.	Khatoda side (Tadoba).
	Timatoun bido (Tudobii).
Campanulaceae Wahlenbergia marginata (Thunb.)	Kurkheda.
A. DC.	
Plumbaginaceae	
Plumbago zeylanica Linn.	Manekshahgadh.
Primulaceae	TT
Anagallis arvensis Linn,	Karva (Ballarpur).
Myrsinəceae Embelia tsjarium-cottam A. DC.	Brahmapuri.

FLORA OF	VIDARBHA
Name	Locality
Sapotaceae Madhuca longifolia (Koenig) Macb. var. latifolia (Roxb.) Chev. Manikara achras (Mill.) Fosberg.	Garlapeth (Wirur). Wirur (Planted).
Oleaceae Jasminum auriculatum Vahl Nyctanthes arbor-tristis Linn. Schrebera swietanioides Roxb.	Rajura. Lakkadkot. Tamurda.
Apocyaaceae Holarrhena antidysenterica (Roth) A. DC.	Sondo (Rajura).
Ichnocarpus frutescens (Linn.) R. Br.	Rajura.
Rauwolfia serpentina (Linn.) Benth, ex Kurz.	Chandrapur.
Wrightia tinctoria R. Br W. tomentosa Roem. and Schult.	Tadoba. Dhaba.
Asclepiadaceae Cryptolepis bachanani Roem. and Schult.	Elgurtola.
Dregea volubilis (Linn. f.) Benth. ex Hook, f.	Nagbhir.
Gymnema sylvestris R. Br. Hemidesmus indicus (Linn.) Schult.	Mesa. Chandur.
Holostemma annulare (Roxb.) K. Schum.	Ettapalli (Bhamragadh).
	Wainganga (Ballarpur). Ghantachowki. Lakkadkot.
Tylophora fasciculata Ham	Ghodejhari (Nagbhir).
Loganiaceae Strychnos nux-vomica Linn. S. potatorum Linn.	Sironcha. Kanhargaon.
Gentianaceae Canscora diffusa R. Br.: Enicostema hyssopifolium (Willd.) C. B. Rob.	Lakkadkot. Rajura.
Exacum pedunculatum Linn E. pumilum Griesb Hoppea dichotoma Willd Nymphoides cristatum (Roxb.) O. K.	Manekshahgadh. Katejhari (Tadoba). Dechali. Dechali.
Hydrophyllaceae Hydrolea zeylanica (Linn.) Vahl.	Bamni (Sironcha).
Boruginaceae Coldenia procumbens Linn. Cordia dichotoma Forst. f. C. macleodli Hook. Heliotropium indicum Linn.	Dechali. Keslaghat. Vadasa. Dechali.

Name Locality

Rotula aquatica Lour. Somanpalli.
Trichodesma indicum R. Br. Ghantachowki.
Var. amplexicaule Cooke.

Convolvulaceae
Argyreia strigosa (Roth) Sant. et Patel.
Ipomaea aquatica Forsk. Aheri.

Jacquemontia paniculata (Burm. f.) Pandarpani side (Tadoba). Hall. f.

Chandur.

Dechali.

Merremia emarginata (Burm. f.)
Hall. f.

M. tridentata (Linn.) Hall. f. ssp. Jamni side (Tadoba). angustifolia (Jacq.) Van Dost.

Solanaceae

Datura fastuosa Linn. var. alba Nagbhir.
C. B. Clarke.

Physalis minima Linn. Mesa.

Scrophulariaceae

Bacopa hamiltoniana (Benth).

Wettst.

B. monnieri (Linn.) Pennell ... Chandrapur.
Limnophila aquatica (Roxb.) Manekshahgadh.
Alston.
Sepangia duleis Linn

Scoparia dulcis Linn. .. Somanpalli.
Sopubia delphinifolia (Linn.) Warora.
G. Don.

Stemodia viscosa Roxb. . . . Vadasa.

Striga angustifolia (D. Don.) Ghantachowki.

Saldanha.

Lentibulariaceae
Utricularia scandens Benj.

(Hassk.) Chatt.

Utricularia scandens Benj. Brahmapuri.
Var. scandens P. Taylor.
Dolichandrone falcata seem var. Lakkadkot.
falcata.

falcata.

Heterophragma quadriloculare
(Roxb.) K. Schum.

Stereospermum personatum

Lakkadkot.

Lakkadkot.

Porla.

Pedaliaceae
Pedalium murex Linn. .. Junona.

Martynia ceae

Martynia annua Linn. .. Manekshahgadh.

Acanthaceae

Adhatoda vasica (Linn.) Nees

Andrograhis echioides Nees

A. paniculata (Burm.) Wall.

ex Nees.

Mercacasa (Bergaon).

Lakkadkot.

Rajura.

Locality

Name

Barleria cristata Linn. Manekshahgadh. B. prionitis Linn. Kistapur. Blepharis maderaspatensis (Linn.) Kistapur. Hevne ex Roth. B. repens (Vahl) Roth Kanhargaon. Manekshahgadh. Haplanthus verticillatus (Roxb.) Lepidagathis cristata Willd. Lakkadkot. L. trinervis Wall. ex Nees Chaudampalli, Ghantachowki. Peristrophe bicalyculata (Retz.) Vadasa. **Petalidium barlerioides** (Roth). Nees. Ruellia tuberosa Linn. Chandrapur. Verbanaceae Clerodendrum multiflorum (Burm. Manekshahgadh. f.) O. Kuntze. C. serratum (Linn.) Moon Elgurtola. Rajura (Planted). Duranta repens Linn. Lantana camara Linn. Lakkadkot. var. aculeata (Linn.) Moldenke. Dechali. L. indica Roxb. Lakkadkot. Phyla nodiflora (Linn.). Greene ... Ghantachowki. Tectona grandis Linn. Lakkadkot. Vitex negundo Linn. Lamiaceae: Anisochilus carnosus (Linn.) Wall. Jamni side (Tadoba). Anisomeles heyneana Benth. ... Aheri. Manekshahgadh. Leonotis nepotifolia (Linn.) Ait. f. Leucas cephalotes Spreng. Lakkadkot. .. Tadoba. L. stricta Benth. .. L. zevlanica R. Br. Lakkadkot. Nyctaginaceae Boerhavia chinensis (Burm. f.) Manekshahgadh. Asbhers. et Schew. f. Ghantachowki. B. diffusa Linn. Amaranthaceae Ghantachowki. Aerua lanata (Linn.) Juss. Digera muricata (Linn.) Mart. Lakkadkot. Chenopodiaceae Chenoiodum album Linn. Chandrapur. Polygonaceae Polygonum barbatum Linn. Kurkheda. var. gracile (Dans.) Steward. Maseli (Bergaon). P. glabrum Willd. Ashti. P. plebeium R. Br. Rumex vesicarius Linn. ... Chandrapur (Cultivated). Aristolochiaceae Aristolochia indica Linn. Wamanpalli. Lauraceae

.. Lakkadkot.

Cassytha filiformis Linn.

Name		Locality
Loranthaceae Dendrophthoe falcata (Linn. f.) Etting.	••	Chandur.
Viscum articulatum Burm. V. nepalense Spreng.	••	Karva (Ballarpur). Maseli (Bergaon).
Euphorbiaceae Acalypha ciliata Forsk		Warora.
A. indica Linn	••	Ghantachowki.
A. malabarica Muell. Arg. Baliospermum montanum Muell Arg.	•	Bamni (Ballarpur). Kanhargaon.
<i>Bridelia hamiltoniana</i> Wall.		Dechali.
B. retusa (Linn.) Spreng. Cleistanthus collinus Benth.	••	Kistapur. Manekshahgadh.
Chrozophora prostrata Dalz.	••	Vadasa.
C. rottleri (Geis.) Juss. ex Sprei		Chandrapur.
Euphorbia elegans Spreng. E. geniculata Orteg.	••	Manekshahgadh. Tadoba,
E. parviflora Linn	λ	Ghantachowki.
Homonoia retusa Muell. H. riparia Lour	NE G	Ashti. Kurkheda.
Mallotus philippensis (Lamk.) Muell. Arg.		Somanpalli.
Phyllanthus asperulatus Hutch.		Nagbhir.
P. lawii Grah. P. maderaspatensis Linn.	11	Wamanpalli. Mesa.
Tragia cannabina Linn.	M	Chandur.
Ulmaceae Holoptelea integrifolia (Roxb.) Planch.	222330	Brahmapuri.
Urticaceae	기식선	
Distemen indicum Wedd. Fleurya interrupta (Linn.) Gaud Streblus asper Lour	 d. 	Chaudampalli. Alapalli. Dhaba.
Moraceae		, ,
Ficus amplissima J. E. Sm.	• •	Aheri.
F. arnottiana Miq F. asperrima Roxb	• •	Wamanpalli. Alapalli.
F. tinctoria Forest f F. parasitica Corner. Var. parasitica Corner.	••	Vadasa.
Casuarinaceae Casuarina equisetifolia J. R. an G. Forst.	d	Ghandrapur.
Orchidaceae Habenaria commelinifolia Wall		Khatoda side (Tadoba).
ex Lindl. H. plantaginea Lindl. Vanda tassellata (Roxb.) Hook G. Don.	ex	Alapalli. Ghantachowki.

Locality

Zingiberaceae

Costus speciosus (Koenig) Smith

Curcuma pseudomontana Grah.

Elgurtola.

Reghevahi (Ghot).

Hypoxidaceae

Curculigo orchioides Gaertn.

Ghantachowki.

Amaryllidaceae

Crinum defixum Ker-Gawl.

Chaudampalli.

Taceaceae

Tacca leontopetaloides (Linn.) O. Kuntze.

Tukumpalli (Allapalli).

Dioscoreaceae

Dioscorea bulbifera Linn.

D. pentaphylla Linn.

Brahmapuri.

Khatoda (Tadoba).

Liliaceae

Asparagus racemosus Willd.

Gloriosa superba Linn.

Iphigenia indica (Roxb.) A. Gray.

Kanhargaon.

Mesa.

Khatoda (Tadoba).

Urginea indica (Roxb.) Kunth

Kukdel (Bergaon).

Smilacaceae

Smilax zeylanica Linn.

Elgurtola.

Pontederiaceae

Monochoria vaginalis (Burm. f.) Presl ex Kunth.

Aheri.

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Xvridaceae

Xyris pauciflora Willd.

Bamni (Sironcha).

Commelinaceae

Amischophacelus axillaria (Linn.)

Rolla Rao et Kammathy.

Garlapeth (Wirur).

A. cucullata (Roth) Rolla Rao et

Kammathy.

Commelina diffusa Burm. f.

Murdannia nodiflora (Linn.)

Aheri. Aheri.

Rajura.

Brenan.

Palmaceae

Borassus flabellifer Linn. Jimalagatta (Planted).

Caryota urens Linn. Wirur (Planted).

Phoenix humilis Royle Maseli (Bergaon).

Typhaceae

Typha angustata Bory and Chaub.

Naleshwar.

Alismataceae

Limnophyton obtusifolium (Linn.)

Lakkadkot.

Miq.

Butomataceae

Tengagocharis latifolia (D. Don.) Dhanora.

Buchen.

Name	Locality
Aponogetonaceae Aponogeton natans (Linn.) Engl. and Krause.	Mul.
Najadaceae Najas indica (Willd.) Cham	Dechali.
Eriocaulaceae Eriocaulon dianae Fyson	Ghodejhari.
Cyperaceae Bulbostylis barbata Kunth Cyperus difformis Linn. C. rotundus Linn. Eleocharis atropurpurea Kunth E. capita R. Br. Fimbristylis littoralis Gaud Fuirena glomerata Lamk.	Dechali. Aheri. Aheri. Chandrapur. Chandrapur. Ghantachowki. Keslaghat.
Andropogon pumilus Roxb. Apluda mutica Linn. Aristida adscensionis Linn. Arthraxon echinatus (Nees) Hochst.	Lakkadkot. Lakkadkot. Rajura. Khatoda (Tadoba).
Arundinella pumilla (Hochst.) Steud. Bothriochloa intermedia (R. Br.) A. Camus. B. pertusa (Linn.) A. Camus	Elgurtola. Jamni (Tadoba).
Coix gigantea Koenig ex Roxb C. lacryma-jobi Linn. var. lacryma-jobi. Cymbopogon martinii (Roxb.)	Pandarpani (Tadoba). Ghantachowki.
Wats. Dactyloctenium aegyptium (Linn.)	Rajura. Ghantachowki.
P. Beauv. Dendrocalamus strictus (Roxb.)	Kanhargaon.
Nees. Dichanthium annulatum (Forsk.)	Aheri.
Stapf. Echinochloa colonum (Linn.) Link E. crusgalli (Linn.) P. Beauv. var. crusgalli.	Rajura. Wainganga (Ballarpur).
Iseilema prostratum (Linn.) Anderss.	Gomni.
Oryza rufipogon Griff Panicum maximum Jacq P. miliars Lamk P. montanum Roxb P. psilopodium Trin Paspolidium flavidum (Retz) A. Camus.	Rajura. Gadhchiroli. Nagbhir. Somanpalli. Armori. Wamanpalli.
Paspalum scrobiculatum Linn. P. polystachyon (Linn.) Schult. P. purpureum Schumach Setaria glauca (Linn.) P. Beauv. S. tomentosa (Roxb.) Kunth Themeda quadrivalvis (Linn.) O. K.	Mulchera. Tadoba. Lakkadkot. Warora. Ghantachowki. Ghantachowki.

Locality

Thelypteridaceae

Cyclosorus parasiticus (Linn) ... Bamni (Sironcha) Farwell.

Adiantaceae

Adiantum incisum Forsk. Lakkadkot. Aleuritopteris albo-marginata .. Wamanpalli. (Clarke) Panigrahi.

Cerotopteris thalictroides (Linn.) Katejhari side (Tadoba).

Brongn.

Marsileaceae

Marsilea minuta Linn.

Ballarpur.

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CHAPTER VII—FLORA OF KONKAN

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CHAPTER VII-FLORA OF KONKAN

1. Introduction:

Maharashtra comprises four regions, viz., Konkan, Western Maharashtra, Marathwada and Vidarbha; but geographically it comprises only two parts viz., Konkan and Desh separated by the long ranges of Sahyadris running almost parallel to the Western coast of India. Konkan is a small narrow strip 27 to 48 km broad and about 800 km long from Goa to the Tapi basin. It is a distinct botanical sub-unit of Malabar province lying in continuation with it. It is a maritime province with high humidity throughout the year, not less than 60 per cent to 70 per cent any time. The vegetation, therefore, is green throughout the year, but the hills are barren. On the west side Sahyadri ranges are highly precipitous and form escarpment several metres in height; e. g. near Amboli village at Tombyachi Wadi, the escarpment is a straight drop of more than 30—38 metres, and a similar situation is there throughout these ranges. The ranges rise high from 518—915 metres at places. They are undulating but not rugged and the peaks are flat-The average height of Konkan plain is hardly 6-9 metres above the mean sea level. But the summits of Mahabaleshwar and Harischandragad are above 1220 metres. Naturally the wall of these ranges on the Western side serves as a watershed. It obstructs the clouds coming with South West monsoons and get intercepted by ghats or passes from West to East. The rainfall at the foot of Sahyadris on the Konkan side, on an average, is 2286 mm—2540 mm., but less in the coastal region. The Konkan is broadly a plain surface formed by the denuded debris and laterite from the Western ghats and some alluvium brought by the fast moving rivers and streams and deposited in depressions and valleys. The streams are generally bunded along their courses right down to their mouth opening into the Arabian sea. A series of terraces are formed of alluvial soil. The coastal strip of 15 to 17 km. is a marshy saline bed due to incursions of the sea. It encourages only salt tolerant plants; but the plains behind are heavily cultivated with rice, ragi and such other crops and vegetables. But where the deposit is a rich alluvium, coconut, betel-nut, mango, nutmeg, cashew are planted between Alibag, Ratnagiri, Sawantwadi and Goa.

At the foot of the mountain there are generally marshy conditions in rainy season; but as soon as the rainy season is over they vanish, as the water flows away rapidly in torrents to sea, and the soil becomes nearly dry on account of its lateritic nature. In contrast to this, on the eastern side of the Western ghats or Sahyadris, there is a gentle slope and deep ravines on Desh side. Rivers small and large bring rich detritus material from the traps to the valleys. Below and through them, the rain water flows slowly enriching the riverbanks and valleys on the Desh side. At several places, there are lateral spurs of Sahyadris separated from each other, creating conditions of high humidity and good drainage, as in the 'Sholas' of Nilgiris, or like those in Khari hills of Assam. These are the Mavals. They are fertile where soil is accumulated.

Konkan comprises the five districts of Thane, Raigad, Sindhudurg, Ratnagiri and Greater Bombay. There is no comprehensive account of the Flora of Konkan despite the fact that according to Hooker and Thomson (1855) Konkan is a part of Malabar botanical sub-province of India. Several distinguished botanists such as Dalzell and Nairne had resided there. As a matter of fact Dalzell was staying at Thane for a long time. Similarly Rev. Father Blatter, Father H. Santapau, Almeida,

McCann were staying at Bombay. But it was only Cooke (1903—1908) who examined all the material then available and gave a fairly good account of plants in this region as were known till that time. After that, Blatter and McCann revised several families of the Bombay Presidency and added about 30 new species to the flora. Similarly Santapau and his students have also revised many families of Bombay Flora and added some new species to it. All this new material, however, has not been incorporated in any book on Flora and, therefore, we have to be guided mainly by the Cooke's account of the flora of the above mentioned coastal districts.

The Flora of Thane has recently been described in a thesis by Bilore (1972), but it is not published. He has described 105 families, 572 genera, 989 species in Thane district, improving upon the Cooke's list. As regards Greater Bombay, the position is the same; but there are very many references to the plants of Bombay and Salsette Island in Cooke's flora.

The Flora of North Bombay is richer than the Flora of South Bombay. It is enlisted by Santapau and G. L. Shah (1970). This list contains many species spread over 109 families. These are the same as are found in North Bombay, but there are many cultivated plants added. Prof. P. V. Bole and his student Miss Randeria have written on the Gamopetalous Phanerogams of Krishnagiri National Park, Borivali. A taxonomic study of monocots of Krishnagiri National Park is made by R. R. Fernandes et al (1954). A third account of Polypetalae and Apetalae of the Krishnagiri National Park, Borivali, is given by P. S. Herbert. G. L. Shah has written a thesis on the Flora of Salsette Island (Ph. D. thesis, 1965) submitted to the Bombay University. For reference to the plants of Bombay and Salsette Islands we have to fall back on Cooke and the Flora of Salsette Island (Malad and Madh area) by Santapau and Shah (1970).

The flora of Raigad district was particularly studied by Santapau with reference to Matheran and neighbourhood. The Hon. Justice Birdwood had written on the same after the middle of the last century. The Flora of Ratnagiri had remained mostly undescribed. The flora of North Ratnagiri is quite similar to that of Bombay, Raigad and partly Thane. The flora of South Ratnagiri has more humid species as in Goa, North Kanara and Malabar. Dr. B. G. Kulkarni has made a study of it which is referred in this book. The flora of Sawantwadi and Goa has been described by a brilliant botanist, Surgeon Dalgado (1896). He was much interested in plant introduction and used to bring a number of plants from Sri Lanka and grow them in Sawantwadi area. The cultivation of pepper, cocoa (Theobroma cocoa) here is largely due to his efforts. Dalgado's list has been improved upon by more recent list by Dr. V. D. Vartak (1966) in his Enumeration of the Plants of Goa and Sawantwadi, and by Dr. B. G. Kulkarni (1979). Since these are more up-to-date lists, they are used here selectively.

Besides these regular works on the flora of Konkan, there are a few stray references to its plants in Van Rheede's Hortus Indicus Malabaricus (1678) and Forest Trees by Talbot (1909). Several other workers have described the plants in their research papers. Two significant areas Raigad and Kanakeshwar are described floristically: Raigad by Vartak (1966) and Kanakeshwar by A. N. Namjoshi and quoted by Ezekiel (1947) in his Plant Sociology Part II, pp. 123—128. We shall summarise our observations on each of these floras, separately.

The canopy is formed by some dominent plants such as Mangifera indica, Saraca indica, Bauhinia vahlii, besides Sterculia colorata (Firmana colorata), Grewia microcos, Ixora coccinea. The second stratum is formed by some climbers and shrubs like Cocculus villosus, Gardenia lucida, Symphorema involucrata, Dioscorea pentaphylla. The herbacious growth consists, especially in rainy season, of Ageratum conyz oides, Barleria prionitis, Daedalacanthus purpurascens, Anogeissus latifolia, a mixture of both dry and moist species. The climbers are Pueraria tuberosa, Capparis sepiaria and Clematis hedysarifolia.

On the Wagreshwar plateau we get mostly the dry and strand plants e.g. Erythrina indica, Bridelia stipularis, Bridelia hamiltoniana, Anacardium occidentale, Ixora nilgirica Ixora, coccinia, Zizyphus rugosa and Zizyphus oenoplia. These are the plants which are also seen in the forests of Jawhar, Borivali, Dahisar etc. One has to note however there are no strictly evergreen trees which occur in patches in the South Konkan or in a continuous belt in North Kanara, or in Mysore forests.

2. HISTORY OF KONKAN FLORA:

Plants of Konkan had attracted attention of botanists since long. Some of them are mentioned in the "Os Colloquiosd' Drogas Simpleles" Garcia de Orta (1565) and also in Henrik van Rheedes' Hortus Indicus Malabaricus (1678-1690), now nearly 300 years old. But the systematic study of Konkan plants began with Graham (1839) who listed them in his well known Catalogue of Bombay Plants assisted by Nimmo. Both Graham and Nimmo were regularly corresponding with Dr. Wight at Kew. Some of their sheets are in Kew Herbarium. Roxbourgh (1820), Brandis (1921), Hooker (1872-1897) have also mentioned them, but the real systemetic study of them was done by two enthusiastic Conservators of Forests in Bombay, Dr. Gibson and Dalzell. Their collections are also in Kew herbarium. When Dr. Gibson went on leave to Europe, Dr. Stocks officiated for him as Conservator of Forests and continued his work. Dalzell, Gibson, Law were energetic collectors of Konkan plants. Law largely concentrated on the plants of Northern Konkan and Bombay, while Dalzell chiefly engaged himself with the collections on plants of Southern Konkan and North Kanara. Talbot (1909), Wight and Arnott (1834) have given figures of many trees in Konkan in their works.

Throughout Konkan, there are depressions either caused by fast moving water courses and rivers, tactonic movements and by changes in the sea level. Due to them, the continuity of the Sahyadri mountains and also of the plains get interrupted at many places; the rain water falling runs straight to the Arabian sea. The water courses and rivers are fast moving. Due to them there are many creeks. Some Sahyadri ranges, though short, run straight into sea. Their banks are covered with alluvium brought from Sahyadris. It is washed away comple ely in many places and the hill tops are barren, or are covered with light shallow lateritic soil. In some cases, there is good vegetation but only in a few places. It is varied in point of species and genera. The vegetation, therefore, is mostly near the foot of the mountain ranges. On the plains, there are only cultivated fields on soil artificially built by stone bunds.

The sea coast and creeks are covered with rich mang ove vegetation and show zonation depending upon the amount of salt contained in the soil.

Generally, the Northern Konkan dries early compared to the South Konkan, which is humid and more or less like Goa and Malabar. For example, Sawantwadi is more like Goa than like Bombay or Northern Konkan. Rivers Ulhas, Vashishthi, Kundalika, Shastri, Urahi, Gad, Ter, as they go to sea, deposit rich alluvium on the banks and in depressions. There is not much of salt in esturian soils as it is annually leached out by rains and river waters. There are good many orchards of coconut, betelnut or mango on their banks in wadis. In between the two Konkans, there are certain areas like Jayagad which are rocky, stony and dry. The vegetation there is much scruby. Nothing grows there except mango trees. There are small islands near the coast of Konkan. They have been investigated by Dr. Untwale under Dr. Mahabale's supervision, but he has not published any account of them. We shall, therefore, give the list of flora of Ratnagiri and Sindhudurg districts and of Thane as representatives of the two areas of Konkan till a fuller account of them is available.

The lists of plants of Konkan especially Sawantwadi including those mentioned by Dalgado, Plants of Greater Bombay district, and lists of plants of mountain tops of Sahyadris like Matheran of Raigad and other areas in the region are given separately.

3. CLIMATE OF KONKAN

The climate of all the districts in Konkan is maritime, humid throughout the year. Rainfall is regular; coastal areas are cooler than interior which gets more rain than coastal areas. At the foot of the ghats rains are heavy.

District Thane:

The climate is characterised by high humidity nearly throughout the year, and in summer by moist heat, which is oppressive. Rainfall is heavy and well distributed during S. W. monsoon season. Cold season is December to February. Summer season is March to June. Monsoon lasts from June to September, October and November are post-monsoon period.

Rainfall.—Average annual rain fall is 2293.4 mm. (90.29"). It increases from coast towards the interior and varies from 1730.5 mm or 68.13" to 90" at Mahim. It is 2588.51 mm (104") at Shahapur in the interior. It lasts from June to September, July is the rainiest month with 40 per cent of the total rain falls in this month. Variation from year to year is not much. The number of rainy days are 83-84. It varies from 67 at Mahim on the coast to 92 at Thane. In 1958, Dahanu had the highest rains. In 1958 on 1st September it was 481.1 mm (18.94") in 24 hours.

Temperature.—Near coast temperatures are little higher than in the district. At Dahanu they are lower in cold season and higher in hot season. Day and night temperatures do not vary much. After February till May, they progressively increase, the hottest month being May. In May daily mean maximum temperature is 32.9°C (91.3°F). Before the onset of rains temperature rises to 37°C (98.6°F) in the coastal parts. In the interior this may be more and the heat oppressive. It is less on the coast. The thunder storms appear in May. From the beginning of November the temperature goes down, but in October and November again rises but not as much as summer. The coldest month is January having mean daily maximum temperature 27.7°C (81.9°F). Mean daily minimum then is 16.8°C (62.2°F). Cold waves sometimes

affect weather when night temperature goes down to 10°C. The highest temperature recorded at Dahanu was 40.6°C (105°F) in April 1955 and the lowest 8.3°C (46.9°F) on 8th January 1945.

Humidity.—Throughout the year, except during monsoons, the sky is clear or lightly clouded. Winds are moderate. During monsoon they are strong. In pre-monsoon period cyclonic storms in Arabian sea move in northerly direction during the latter part of summer and in postmonsoon period, affecting the coastal areas. Wind sometimes reaches a gale force on the coast with thunder and storm in late summer and in October.

District Raigad:

Climate of this district is typical of the west coast of India. Summer is March to May; June to September is rainy. October and November are post-monsoon period or of retreating monsoon. December to February are cold.

Rainfall.—S. W. monsoon begins in the first week of June and continues till the beginning of October. Average rainfall for the district is 3028.9 mm (121.25"). It rapidly increases from coast towards Western Ghats, which form the eastern border of this district. On the coastal plain it decreases towards north. Uran and Alibag on the coast at northern end get annually 2072.3 mm (83.58") and 2080.8 mm (83.92") rain, respectively. Matheran on the ghats gets 5167.5 mm (206.45"). October is the rainiest and so also July, but less than October. Very rarely in 55 years, it is either more or much less. Annual rainfall for the district for 50 years is 2600 to 3600 mm (104.36" to 144.73"). The number of rainy days is 94. They are 82 at Uran and Alibag and 108 at Matheran.

Temperature.—Diurnal and seasonal variations are not much Temperature increases from March to May. May is the hottest, with mean daily maximum temperature 31.7°C (89.1°F). Daily minimum is 26.4°C (79.5°F). Breezes are there even in summer months. Temperature comes down with monsoons; towards September, October and November weather is like that of summer. December to February are cool. Air is humid throughout the year. On an average, humidity is 80 per cent in S. W. monsoons. In rest of the year relative humidity varies from 65 to 75 per cent. In May and October, there are light clouds. But in rainy season, the sky is heavily clouded. Winds are moderate from January to March. In April they become strong but variable in direction. From May they blow S. W. to N. E. Cyclonic storms occur in post-monsoon period and to a small extent in May. In the coastal area they bring heavy rains and thunder storms in April and May.

Greater Bombay:

Rainfall.—The moist heat and summer are oppressive from March to November. Heavy S. W. monsoon begins in the 1st week of June. December to February is cold season. March to June is summer. June to September is rainy season. October and November is post-monsoon period. Average annual rainfall is 1917.3 mm. (79"). There is not much variation in rain in Greater Bombay, but pattern of rainfall for individual days is not uniform. In some places it is very heavy and at others it is much less. Variation from year to year is noticeable. In 50 years annual

rainfall is less for 2-3 years and less than 80 per cent of the normal for 10 years. Rainfall is due to S. W. monsoon. July is rainiest having 1/3rd of annual rainfall. Some of it occurs with thunder storms in May and June and in post-monsoon months. The rainfall varies from 1700 mm to 2300 mm in 26 years out of fifty. Average rainy days are 73.

Temperature.—Santacruz is slightly warmer than Colaba at the sea coast. Nights are colder at Santacruz in cold season. Temperature goes on increasing after February till May, the hottest month. The mean daily maximum temperature in May is 33.3°C (91.9°F) at Colaba. and 33.3°C (91.9°F) at Santacruz. The mean daily minimum temperature in May is 26.9°C at Colaba and 26.2°C at Santacruz. high humidity throughout the year, particularly in summer, weather is oppressive. Sometimes maximum temperature goes to 40°C (104°F). But sea breezes lessen heat. After the advent of monsoon in June. weather becomes cool. Towards the end of south-west monsoon, the day temperatures rise slightly and a secondary maximum is reached in November. Nights become cool after the monsoon. After November day temperature decreases. January is the coldest month. Daily mean maximum is 29.1°C at Colaba, and 30.6°C (87.1°F) at Santacruz. The mean daily minimum temperature is 19.4°C (66.7°F) at Colaba, and 16.3°C at Santacruz. In the cold season, due to weather disturbances mean temperature drops to 10°C (50°F). The highest temperature recorded at Colaba in April 1955 was 40.6°C (105.1°F), and at Santacruz was 42.2°C (108°F) in the middle of April 1952. Lowest minimum at Colaba was 11.7°C (53.1°F) on 15th January 1935, when at Santacruz it was 7.4°C on 22nd January 1962. Colaba experiences more humidity than Santacruz. Mornings are more humid than noon in Bombay. In June to October relative humidity is 75 per cent and above. During November and February the relative humidity is 50-65 per cent in the afternoon which is the driest part of the year. In monsoons the sky is heavily clouded, but not so afterwards. During December to March it is clear or lightly cloudy. Cloudiness increases with the progress of S. W. monsoon season. Winds are moderate in monsoon but heavy before blowing S. W. to N. E. In the latter part of the summer, in post-monsoon period storms occur due to depressions in Arabian sea, with heavy rainfall and gusty winds. Thunder storms are not uncommon in September and October associated with rain.

Ratnagiri and Sindhudurg Districts1:

Rainfall.—Climate of the two districts is moist but relaxing and healthy. Rainfall is regular and plentiful. Seasons are usual as elsewhere. But the rainfall at different places is quite different. At Amboli at the foot of Western Ghats it is twice as much as in other parts of the districts. Therefore, it is difficult to know representative average for the whole of districts, except at the foot of Ghats. Average annual rainfall has been calculated at 3188 mm (127.52"). It increases rapidly towards the Ghats on the eastern border of the districts. Rains near the Ghats are very heavy, e. g., at Amboli which gets on an average 7446.00 mm of rain. The coastal places such as Malwan and Deogad get 2155 mm and 2247 mm rain, respectively. The rainiest month is July, when more than 1/3 of the rain falls. The annual mean rainfall varies between 2600 and 3800 mm. The number of rainy days is 101. At Dapoli sometimes rain is heavy in June.

^{1.} Ratnagiri was divided into two districts, namely, Ratnagiri and Sindhudurg, in 1981.

Temperature.—It rises from March to May. May is the hottest, but it drops by 3-4°C with the onset of rains. It again increases from October to November. Day temperature is usually lower. November is as hot as May. Night temperature is lowest in January, 20—25°C. Nights are pleasant even in the hot months, but in the interior the weather is oppressive particularly at foot of the Ghats. Maximum temperature along the coast seldom goes beyond 38°C (100.4°F), but in the interior it may reach 40°-41°C (104°F-106°F). Due to proximity of sea the weather is humid throughout the year. In winter humidity goes below 50 per cent. The sky is clear except in monsoons when it is highly cloudy. Winds move in S. W. direction and are quite strong and move in the opposite direction from North and East in the mornings in other months. After monsoon period, they blow West and N. W. The district experiences very strong winds and gales with cyclonic storms, and heavy rains in the coastal areas, as they develop in Arabian sea. Thunder storms are common in post-monsoon period.

4. Soils of Konkan:

Most of the soils in Konkan are leached lateritic and reddish. They are originally derived from Deccan traps but due to heavy rainfall and fast moving streams within a short distance they get thoroughly leached out. They contain dehydrated iron oxides which impair red colour to them having various shades of red or brown colouration. Even the silicic acid and calcium salts are washed away by the heavy rains, including silicon sequioxide. They contain some nitrogen but practically no lime. They have very low retentivity of water, otherwise they are good. They are very suitable for horticultural crops like mango, cashew, coconut, areca, chikku, pineapple, vegetables, etc. They are hardly 0.304 to 0.914 metres deep and not much fertile. But they are not sticky, and have good aeration. The crops of nagli, sava, and vari grew well. They need to be provided with nitrogen and lime. A new project for urea and nitrogen fertilizers is being set up at Thal Waishet near Alibag.

Along the river banks and near estuaries the soils are alluvial and fertile. Near the sea coast and on tops of hills soils called *Mal* are poor or 'Varkas'. At Dapoli, Rajapur, Ratnagiri and Guhagar the soils near the sea coast are deposited with deep sandy loam. They are recent deposits. They have not been fully matured and hence look yellow.

5. VEGETATION OF KONKAN

Starting from the coast, the vegetation may be described as follows:

All along the coast line, there are tidal swamps and mud flats mostly covered by mangroves. Behind them are the sand binders and strand forests, but not everywhere. They occur especially where the soils are sandy and the coast is not muddy. There are semi-evergreen forest pockets containing teak (*Tectona grandis*) and tall woody creepers mixed with tropical species. There are a few pockets of evergreen forests in Sindhudurg but nowhere they are continuous, or form zone of evergreen forest.

On the hill side towards west there are dry deciduous forests of *Tectona grandis* (Teak); but the teak is of poor type not having large size. On the Sahyadri ranges, the forests are not very thick. They are of the dry deciduous type. The pockets of tropical evergreen and semi-green species are more in South Ratnagiri, the richest area being Sawantwadi next to Union Territory of Goa. They have moist deciduous forests.

Near estuaries of streams and river banks there are tidal forests of mangroves and other species. The palm Coconut, Cocos mucifera fringes behind the coastline. Palmyra Borassus flabellifer grows on low hills and forms skyline. At places like Revdanda, Alibag, Vasai, Hyphaene indica grows in patches. In Thane district Phoenix sylvestris occurs near wadis e. g. at Dahanu, and Areca catechu at Uran, Pule, Dive Agar, etc.

The Flora of Kanakeshwar is typical of the vegetation in Konkan. On the top of Sahyadri hills and on slopes there are typical dry deciduous forests. However the hill passes from Konkan to Desh such as Amba, Amboli are rich in varied vegetation. They are a treasure of various interesting species of practically all groups. They represent, in part, ancient vegetation in this region as they contain some rare and endemic species as well as moist deciduous species.

Thane:

Reference to Thane plants has been made by Dalzell (1850—52), Dalzell and Gibson (1861), Nairne (1894), Cooke (1901—1908) and others. The flora of Thane district has been recently studied by Bilore (1972), but his work is unpublished. Only general account of angiosperms is given here.

Thane forests abound in good teak (Tectona grandis) and Adina cordifolia. The trees are fairly tall: vegetation is of mixed deciduous type, we do not get any evergreen species. During monsoons a very distinctive ephemeral flora appears and also disappears quickly. It is of the same nature as the monsoon ephemeral flora elsewhere; however it is richer in species. It appears on the mountain tops, flats, slopes, and plateaus formed by the successive erosion of the trap layers. These species quickly germinate and form thick compact stands and cushions. They form seeds and disperse them in a short time. After the seed dispersal they disappear abruptly. Their list is given separately. They are very conspicuous on Tungarli hills and outer ranges of Kosbad hills.

Another important part in the vegetation of Thane district is that of conserved grasslands. These grasslands are mainly preserved for cattle fodder. They consist of edible grasses. They grow in a belt from Raita, near Kalyan, Bhivandi to Palghar, Dahanu, Umbergaon and continue beyond Vapiin southern Gujarat. They lie in a narrow strip of land at the foot of low hills of Sahyadri ranges facing sea. Conditions for the growth of grasses are optimum and hence the grass produced is plentiful. Side by side with them some tall grasses like *Themeda triandra* also grow, but their proportion is relatively small. It is with the help of these fodder grasses that the Dapchari Milk Scheme has been planned in Thane districts. It is however necessary to remark that these are not the real grasslands like Prairies or Steppes. They are man-made grasslands or 'Kuran'.

The third type of vegetation in Thane is that of shore plants and sand plants. Muddy shore plants or mangroves are nearly the same as in Bombay Island, but the sea shore in the northern part of Thane district is sandy. Many sand binding plants grow freely. Among them is a very noteworthy grass Spinifex squarrosus.

The fourth type of vegetation in Thane district is of the monsoon deciduous teak forest. However as there is no comprehensive flora of Thane district published, we have to study it with the help of whatever is

published. Many rivers cross Thane district and go to Arabian sea. The river banks are full of mangroves. The marshy areas are not much saline.

Recently Dabhade (1966) has published a list of flora of Ulhasnagar near Kalyan. Much of it is on the river bank.

It will be seen that it is of the same type as in other districts of Konkan.

The well-known hot water springs at Vajreshwari are in Thane district. Their algal flora has been worked out by Prof. Mrs. E. Gonzalves (1947).

Raigad:

The flora of this district also is not worked out, but of Matheran and Raigad hill fort has been described by Birdwood (1886), Cooke (1901— 1908) and of Raigad by Vartak (1966). Matheran is a plateau, not very extensive nor very broad, hardly a mile wide and three miles long. It abruptly ends on the southern side at Jacob's Ladder looking toward the Duke's nose. It forms a precipitous slope on the western side facing sea. It is quite rich in vegetation and contains about 140 flowering plants excluding grasses, ferns and mosses. There are as many as seven species of Strobilanthes noticeable from foot to the top of this isolated hill, about 620 metre high. The forest on the top is rather stunted and is of the monsoon deciduous type, green in monsoons but dry after rains for the most part of the year. There are many deciduous species along with some moist deciduous species, such as Garcinia indica, several ferns and mosses, bushes of Ligustrum nilgirense, Salix tetrasperma, Glochidion hohenckeri, Flacourtia montana, kydia calycina, Artocarpus insigne. They form the canopy. They mostly grow in depressions and valleys. A lot of debris accumulates in valleys. The seedlings of Memecylon edule, and Musa superba (M. ensete) grow in the ledges of rocks and on slopes. On the top of the hill, there is very little lateritic soil. Due to heavy rains much of it is washed down into the valleys. The vegetation on the top is of the monsoon deciduous type but not so uniform.

Flora of Raigad is similar, but is rich, as there is a continuous stream of humidity moving from sea towards the interior. Its vegetation is also of mixed deciduous forest type, and it has some semi-evergreen species from North Kanara and Goa.

A little further below the Fitzgerald ghat going to Mahabaleshwar the Savitri riverflows. In the midst of its bed near Mahad, there are two hot springs but nobody has worked on their flora.

Greater Bombay:

The third important district is Greater Bombay with Salsette island. It extends from the Island of Bombay to Krishnagiri National Park at Borivali and the forest of Borivali. The flora of Greater Bombay has not been worked out. We know partly the flora of Krishnagiri National Park through the work of Santapau and Randeria (1955) and from the work of Dr. G. L. Shah (1970) who has studied the plants of Madh and Salsette islands. Here the sea makes incursion at many places and we find rich mangrove vegetation at a number of places like Bandra, Ghodbunder and Bhayander creeks. The forest in the valley of Borivali hills contains several monsoon deciduous species and also the Krishnagiri

National Park, similar to those in the valleys of Western Maharashtra, studied by Bole and his associates. They dry up early due to less humidity and no rains for about 8 months. During rains there is a rich monsoon ephemeral flora described by Santapau (1960), Mahabale (1966) and others.

Ratnagiri and Sindhudurg Districts:

The flora here has the same features as of Bombay and Thane. Some of the plants are described by Nairne (1894) and earlier by Dalzell (1850-52), Dalzell and Gibson (1861). The northern part of Ratnagiri is less humid than southern part separated by the creek of Malwan, Flora is similar to the flora of Greater Bombay, but that in South Konkan below Kumbharli Ghat upto Phonda, below Ramghat and Amboli is different. Here the soil is largely sandy and loamy. The rain lasts longer. There is great abundance of trees which look green throughout the year. But for the humidity throughout the year, they would have become completely deciduous. Many essential oil yielding grasses e. g., Cymbopogon nardus, members of Compositae, Verbenaceae and Labiatae grow well. A large number of medicinal plants also grow well in Sawantwadi area. It is very suitable for the growth of fruit trees and palms, Cashewnut introduced by Portuguese, and nutmeg (Myristica fragrans) grow very well. Theobroma cocoa was introduced by Dalgado in Sawantwadi area and is growing well. Mango, black Pepper (P. nigrum) p. longum, Mentha viridis, Mentha piperita, Hydrocotyle asiatica, do well. Eucalyptus spp. are introduced in North and South Ratnagiri. The plants of Ratnagiri are a mixture of Konkan, Karnataka (North Kanara), Malabar and Goa plants. In the north Konkan palms, coconut and betelnut thrive well around Kudal, Shriwardhan, Roha, Alibag. At Kanakavali, thera is a good forest of monsoon deciduous species and it extends also to Phonda and Amboli ghats. Ghats all along Sahyadris are a unique conservatory of forest trees. Different plants grow at different heights as they need different variable climate.

Ratnagiri itself has equally good flora similar to that in other districts of Konkan. All the districts of Konkan seem to possess somewhat similar flora. At Ratnagiri, there is good forest of mangrove and strand plants.

6. FLORA OF GREATER BOMBAY

A comprehensive flora of Greater Bombay district is yet to be prepared. We have therefore to rely on rather scanty information given by Dalzell and Gibson, Cooke and by various papers of Blatter, Santapau and his associates, and stray references to Bombay plants by various authors. The most important part of the flora of Bombay lies to the north of Bombay and in Salsette Islands where it is much destroyed. The sea shore flora is the same except that the proportion of different mangroves changes according to locality. After Independence, a special park called Krishnagiri National Park, Borivali has been created. It has effectively preserved certain species which otherwise would have disappeared. The full flora of this Park has not been published. Account of plants and vegetation in its certain parts has been given in a paper by Santapau and Randaria. "The botanical expedition of the Krishnagiri National Park, Borivli near Bombay" published in J. B. N. H. S. Vol. 53 (i) pp. 184-200, 1955. The river Dahisar passes through the middle of it. This part is rather barren but the valley to the north is full of plants typical of Bombay Island. Kanheri point is the highest peak 465 metres (1516')

above the sea level. The hills as usual are the Deccan trap hills with wide plateaus on the top at many places. They are derived from volcanic rocks some of which are braccicated, especially in the region of Kanheri caves. Here both the acid and basic lava flow are found. The average rainfall is 190 cm. Much of it falls in the months of June and July. Driest months are December to April. About 95 per cent rain comes in the rainy season, and only 5 per cent during the rest of the year. Generally the highest temperature is in May and the lowest in January. Winds are mostly from north to north-east, but during the monsoons till about August they are from south-west to north-east. The vegetation is of the Southern Tropical moist deciduous type, but at many places it borders on the dry deciduous type, particularly on the eastern face. Dahisar river banks contain woody species such as Holarrhena antidysenterica, Mangifera indica, Woodfordia fruticosa, cumini, Homonia riparia, Pongamia pinnata and such small trees. Behind these there are many climbers like Derris scandens, Combratum ovalifolium, Argyreia nervosa, Smilax zeylanica, Jasminum malabaricum. In drier parts Argemone mexicana, Coldenia procumbens grow in abundance.

In the bed of the river a number of water plants Limnophila sessiliflor a Nymphaea pubescens, Limnanthemum cristatum occur. In the semi-dry places near the river Coldenia procumbens, Sphaeranthus indicus, Grangea maderaspatana, Polygonum plebejum, Dopatrium juneceum, Hydrolea zeylanica, Lindernia sps. occur.

Vegetation along the main road, especially in the dry months allows only xerophytes like Euphorbia hirta, Alysicarpus sp. and the Desmodium species to survive. Species like Gomphrena globosa, Acanthospermum hispidum and such others are naturalised here.

The vegetation of the north and south hills along the main road it clearly a secondary formation; the original forest has alomst completely disappeared from the whole of the park area. The hills are 83' in height The forest may be said to be of the monsoon deciduous type. On the top Terminalia crenulata, Tectona grandis, Garuga pinnata, Bridelii squamosa, Butca monosperma, Bauhinia racemosa, Ficus gibbosa, Mallotu A few trees of Adina cordifolia Oroxylun philippinensis are found. indicum, Kirganelia reticulata occur and form open canopy. The seed lings of Wrightia tinctoria, Holarrhena antidysenterica, Morinda tinc toria. Adenanthera pavoniana, Carvia callosa, Solanum indicum, Aniso melea hayneana are found on the hill slopes and at the margin of the forest Clausena indica is found in the valley slopes of the upper layers. Th ground layer is made up of Hemigraphis latebrosa var. hyaneana, Haplan thus tentaculatus var. neesiana, Orthosiphon glabratus. Some climber grow also on top of hills. In addition to these Dalbergia sp. Aspidor. teris cordati, Cansjera rheedii, Pueraria tuberosa, Cissus and Ampelocissu species are found throughout the forest. Bambusa bambos forms clumps Most of the southern area is deciduous But the humidity being high these forests do not look all dry as they do elsewhere. Above th Kanheri caves Sterculia urens, Salmalia insignis, Tectona grandis, Lanne grandis, Carvia callosa, Barleria lawii, Haplanthes verticillari, Hymenodictyon comorense are found.

There are several natural and artificial tanks or pools on the top of the hills. There is hardly any soil on the top. Here one notices Tremma orientalis, Erythrina variegata var. orientalis, Adina cordifolia, Irewia polycarpa, Lantana camara grow in drier parts every where and also Dioscorea hispida, Smilax zeylanica. But a characteristic feature of these hills are the monsoon plants listed below:—

Melothria maderaspatana.

Melothria heterophylla.

Cucumis callosus.

Trichosanthes bracteata.

Momordica dioica.

Luffa acutangula L, var. amara.

Neuracanthes sphaerostachyus.

Thumbergia fragrans.

Asystasia dalzelliana.

Sopubia delphinifolia.

Striga asiatica.

Eranthemum purpurascens.

Asteracantha longifolia.

Barleria pratensis.

Haplanthus pentagulatus var. neesiana.

Haplanthus verticillatus.

Rungia pectinata.

Rostellaria procumbens.

Costus speciosus.

Rhamphicarpa longiflora.

Murdannia scapiflorum.

Lindernia sps.

On the top of Kanheri caves Dipcadi saxorum, Eulophia ochreatanum, Utricularia striatula, Segonia crenata, Ophioglossum fibronim, Eriocaulon, sp. grow. Several grasses are there, but practically no trees on the top of caves. The origin of Krishnagiri National Park plants is as follows:

सत्यमेव जयत

6.1 Origin of the Plants in the Krishnagiri National Park

		Number	Percentage
Plants of			
Bombay State (old)	· •	4	2.13
Bombay and South India	120 ° 949	15	8.55
Bombay and other parts of India	a	48	25.66
West Asia and North Africa	· •	19	10.16
East Asia and Malaya	,,,	47	25.13
Tropics ,.		54	28.87

The presence of East Asian, Malayan and Tropical climbers is noteworthy. The family-wise distribution known is as follows:

Families of Gamopetalous Angiosperms of Krishnagiri National Park, Boriyali

Order	Fam	ily			No. of spp. in Kr. Nat. park	Hooker's orders	Fisher's orders
(1)	(2)			(3)	(4)	(5)
1	Compositae	••	••	••	36	7	7
2	Acanthaceae	••	••		27	6	4
3	Convolvulaceae	• •	••	••	22	••	• •
4	Rubiaceae	• •	••	••	20	4	3
5	Scrophulariaceae		••	••	13	• •	••
6	Solanaceae		••	••	9	• •	••
7	Labiatae	••	••		8	9	9
8	Verbenaceae	••	- 8		6	• •	••
9	Asclepiadaceae				6	••	••
10	Apocynaceae		Service of the servic		6	••	••
11	Bignoniaceae		SE	١.	6		• •

Next we shall consider plants in other parts of Bombay. They are listed below :-

6.2 Important Plants of Bombay Island:

Kleinhovia hispida ...

Species	{		Locality	
Anonaceae		सन्यमेव	जयते	
Polyalthia longifolia		***	Jijamata Udyan (Victoria den) Byculla, Thane, Bori	
P. pendula	 n	• •	Do. Do,	
Cruciferae			D.	
Brassica actinophylla	434	•.•	Do.	
Capparidaceae Crataeva religiosa	•••	••	Do.	
Bixaceae Bixa orellana			Do.	
Cochlospermum gossyph	ım	•••	Do.	
Bombacaceae Ceiba pentandra	•••	• •••	Do.	
Sterculiaceae			Do.	
Guazuma tomentosa Helicteris macrophylla;	••	• ••	Do,	
			77 (m. d., O) 1 (D., 1 1)	

.. King's Circle, Borivali,

Species			Locality
Sterculia alata 🗼			Jijamata Udyan (J. U.) Byculla.
S. villosa		• •	Do.
Sterculia colorata		٠.	Do.
S. foetida:	• •	• •	Do.
Rutaceae			
Aegle marmelos		• •	Do.
Atlantia monophylla			Do.
Feronia elephantum	• •	• •	Do.
Filicium decipiens	• •	• •	Do.
Meliaceae			
Azadirachta indica		• •	J. U. Byculla, Borivali, Thane.
Melia azadirach			Do.
Swietenia mohogonii	• •	• •	Do.
Swietenia macrophylla	• •	• •	Do.
Sapindaceae			
Schleichera cleosa	••		Do.
Anacardiaceae	50	120	100
Anacardium occidentale	(2.58)	i i i	Do.
Semicarpus anacardium	4		Do.
Leguminosae	P. Car		74
Papilionaceae	7.7	146	4.4
Butea monosperma	est d	E41. P	Do.
Dalbergia sisoo.	ALC:	7/400	NO.
Sesbania grandiflora.	Michi-		Do.
Clitoria ternata Pongamia glabra			J. U., Thane, Borivali.
	440	यमव	기식대
Caesalpinaceae			I II Broulle
Saraca indica Amherstia nobili	• •	• •	J. U., Byculla. Do.
Bauhinia racemosa	• •	• •	Do.
B. purpurea	• •	• •	Do.
Caesalpinia cariaria			Do.
Cassia fistula			Do.
C. noďosa			Do.
C. renigera		٠.	Do.
C. siamea	• •	٠.	Do.
Plumeria rubra Thevetea peruviana	• •	• •	Do. Do.
Thevereu peruvunu	• •	• •	ъ.
Convolvulaceae			
Ipomoea biloba			Juhu.
l. aquatica			J. U. Byculla.
I. palmata	• •	• •	Thane.
I. quamoclit	••	• •	Thane.
Acanthaceae			
Peristrophe bicalyculata		• •	Borivali, Thane.

Species				Locality
Euphorbiaceae				
Mallotus phillipine	ncic			J. U. Byculla,
Melaleuca leucode		••	••	Do.
Phyllanthus distich		• •	• •	Do.
		• •	• •	Do.
Putranjiva roxburg	7111	••	• •	10.
Urticaeae	c 1.			D-
Artocarpus integrij	olia	• •	• •	Do.
A. mobilis	• •	• •	• •	Do.
Collevillia racemos	ia	• •	• •	Do.
Trema orientalis	• •	• •	• •	Do.
Streblus asper	• •	. •	• •	Do.
Mimosae				
Acacia catechu				Do.
A. auricuiformis				J. U. Borivali.
A. arabica				Do.
Adenanthera pavor	ina			Do.
Albizzia lebbek				J. U., Parel.
		~		3
Rhizophoraceae		FEE	rest	MEGO.
Avicennia sp. (alba	. ? off.	icinalis	?)	Thane.
Rhizophora mucro		7		Thane.
zun-opnoru minoro.	••••	SCHE		\$3707
Combretaceae		100	4733	P(4)
Terminalia arjuna		0.0	Lin:	J. U. Byculla.
T. bellerica		1.9	133	Do.
_	••	of the	L	Do.
T. catappa	• •	ALT.	7500	11211
Bignoniaceae		Michie S		805-54 1
•		-		Do.
Bignonia megapota	imica	100	rita.	जयन Do.
Cresentia alata	• •	4100		_
C. cujete	• •	• •	• •	Do.
Sapotaceae Chrysophyllum tub	erosum	ı.		
Apocynaceae				
Plumeria alba				Do.
+				
Monocotyledons			٠.	Do.
•				
Araceae				
Pistia stratoitis			٠.	Do.
Orchidaceae				
Acampe sps.				Do.
- "				
Musaceae				
Musa sp.				
Ravanela madagas	carensi	is		Do.
			•	
Liliaceae				
Chlorophytum tube	erosum		٠.	Borivali.
A-127-28-A.				
++-1=1				

Species			Locality
Palmae			
Roystonea regia		••	J. U. Byculla.
Rhapis humilis:			Do.
Livistona chinensis			Do.
L. rotundifolia:			Do.
Licuala spinosa			Do.
L. grandis			Do.
Borassus flabeilfer Phoenix sylvestris.	••	••	Sea shore,
Pandanaceae			
Pandanus odoratissimus	• •	• •	Ghodbunder, Borivali,
Lemnaceae			
Lemna minor			J. U. Byculla.

6.3. Flora of Salsette and Madh Islands

Madh and Salsette are the component parts of Greater Bombay district. They are two separate islands and have very distinct flora. It has been worked out by Dr. G. L. Shah who has published plants found on them including weeds and grasses found. However his entire work is yet to be published and therefore, lists of plants he has recorded are reviewed here. They offer a fair glimpse of the flora of these places, but not the entire picture of it. The Madh island belongs to the Bombay sub-group of islands and Salsette. Much of its flora has gone buried under the debris. Only a small portion of it still remains near the Bandra bridge near Bandra Station on Eastern Highway going to Santacruz Air-port. Here patches of mangroves are still visible, though much of it is destroyed at Mahim.

Enumeration of Important plants of Salsette and Madh Islands of Bombay

Family Ranunculaceae Clematis hedysarifolia DC.

Anonaceiae

Anona squamosa Linn.

Manispermaceae

Cissampeles pareira Linn.
Cocculus hirsutus (Linn.) Diels
Cyclea burmanni DC
Tinospera cordifolia (Willd.)
Miers ex Hook and Thoms.

Nymphaeaceae

Nymphaea nouchali Burm. N. stellata Willd.

Papavaraceae

Argemone mexicana Linn. anexotic weel.

A-127-28-B.

Cruciferae

Brassica nigra (Linn.) Koch. Raphanus sativus Linn.

Capparidaceae

Cadaba fruticosa (Linn.) Druce. Capparis sepiaria Linn.
C. zeylanica Linn.
Cleome burmanni W. and A.
Cleome chelidonii Linn. f.
Gynandropsis gynandra Linn.
G. viscosa Linn.

Violaceae

Hybanthus anneaspermus (Linn.) F. Muell.

Flacourtiaceae

Flacourtia indica (Burm. f.) Muell.

Polygalaceae

Polygala chinensis Linn.

Caryophyllaceae

Polycarpon prostratum (Forst.) Aschers & Schewinf,

Portulacaceae

Portulaca oleracea Linn.

Elatinaceae

Bergia emmannioides Heyne ex Roth, B. capensis Linn.

Guttiferae

Calophyllum inophyllum Linn, Mammea suriga (Buch-Ham ex Roxb.) Kosterm,

Malvaceae:

Abelmoschus esculantus (Linn.) Mosuch.

A. manihot (Linn.) Medic.

Abutilon indicum (Linn.) Sw.

Azanza lampas (Cav) Alel.

Hibiscus cannabinus Linn.

H. furcatus Willd.

H. lobatus (Murr.) O. Kuntze.

H. vitifolius Linn.

Malachra capitata Linn.

Sida acuta Burm, f.

S. cordifolia Linn.

S. shembifolia L. var. ratusa (Linn.) Masters.

- S. apinosa Linn.
- S. varonicifolia Lamk.

Thespasia populnea (Linn.) Soland ex Corr.

Urena lobata Linn.

Bombax ceiba Linn.

Sterculeaceae

Helicteres isora Linn.
Melochia corchorifolia Linn.
Sterculia foetida Linn.
S. villosa Roxb. ex DC.
S. urens Roxb.
Waltheria indica Linn.

Tiliaceae

Corchorus asituans Linn. C. olitorius Linn.

Grewia abutifolia Vent ex Jurs.

G. columnaris Sm.

G. disperma Rottel. ex. Spreng.

G. subinaequalis DC. G. tiliaefolia Vahl.

Microcos paniculata Linn. Triumfetta pentandra A. Rich.

Balsaminaceae

Impatiens balsamina Linn. var. balsmina.

Oxalidaceae

Biophytum sensitivum (Linn) DC. Oxalis corniculata Linn.

Rutaceae

Aegle marmelos Corr. Feronia limonia (Linn.) Sw.

Burseraceae

Garuga pinnata Roxb.

Meliaceae

Azadirachta indica (Linn.) A. Jussu.

सत्यमव जयत

Opiliaceae

Canalara sheeldii Gmel.

Celastraceae

Celastrus paniculata Willd.

Rhamnaceae

Zizyphus glabrata Heyne ex Roth.

Z. mauritiana Lamk.

Z. oenoplia Muell.

Z. rugosa Lamk.

Vitaceae

Ampelocissus latifolia (Roxb.) Planch.
Caryratia rapanda Vahl.
Leea cinera Laws.
L. edgeworthii Santapau.
L. macrophylla Roxb. ex Hornem.

Sapindaceae

Sapindus laurifolius Vahl.

Cardiospermum halicacabum Linn.

Anacardiaceae

Anacardium occidentale Linn.

Buchanania lanzan Spreng.

Lannea coromandelica (Houpt)

Merill.

Mangifera indica Linn.

Semecarpus anacardium Linn.

Cooke (1905) in his Flora of the Bombay Presidency has described 337 species as occurring in Konkan including Sawantwadi. They include many floristically important plants that occur in Belgaum, Dharwar, North Kanara and Sawantwadi. Botanically these are rich districts but are a part of Karnatak State except Sawantwadi in Maharashtra. But they were given without localities or in general vague terms such as Konkan country, etc. The list therefore is not given and the plants of only five districts of Thane, Kolaba (Raigad), Greater Bombay, Ratnagiri and Sindhudurg are considered here.

Plants of Salsette and Madh Islands-Monocoty ledons

Plants of Saisette and Maan Islands—Monocol	vieuons
Species	Flowering season
Hydrocharitaceae: Blyxa echinosperma (Clke.) Hook F Hydrilla verticillata (Linn. F) Royle Ottelia alismoides (Linn.) Pers	November-December November-December October—December
Orchidaceae:	
Acampe pramorsa (Roxb.) Blatt and M. C. Dendrobium ovatum (Willd.) Kranz. Habenaria marginata Coleb. Rhynchostylis retusa (L.) Blume	March—June December-January August-September January—July
Zingiberaceae:	
Costus speciosus (Koening ex Ratz) Curcuma inodora Blatt	July-September June-August
Hypoxidaceae: Curculigo orchioides Gaertn	June—August
Taccaceae: Tacca leontopataloides (L) D. Kuntze	July—September
Dioscoraceae: Dioscorea alata Linn. Dioscorea belophylla Voigt. Dioscorea bulbifera Linn	August Soutemban
Dioscorea valiosjera Linn	August-September August-October November
Liliaceae:	

June—August

August-September

Asperagus racemosus Willd. var Javanicus

•-•

٠.

Chlorophytum tuberosum Baker

Gloriosa superba Linn.

Baker.

Iphigenia indica (Linn.) A. Gray	July
Scilla hyacinthina (Roth) Macbr	June-July
Urginea indica Kunth	March-April
A-	
Smilacaceae:	
Smilax zeylanica Linn	September-October
Commelia	
Commelinaceae:	
Commelina banghalensis Linn	July—October
Commelinea hasskarlii Clke	July—November
Commelina diffusa Burm	August—September
Commelina subfruticosa Blume	July—October
Cyanotis axillaris (Linn.) Schult. f	August—January
Cyanotis fassiculate Schult. f	JulyOctober JulyNovember
Cyanotis fasciculata Schult, f	July-August
Murdannia semiteres (Dalz.) Sand Murdannia spiratum (Linn) Srueck	September
Murdannia spiratum (Linn) Srueck	September
Palmae:	
Borassus flabellifer Linn	February—April
Caryota urens Linn	1 cordary—April
Cocos nucifera Linn.	
Phoenix sylvestris (Linn.) Roxb	January-March
Thomas syresins (Linn.) Rozo.	January Waren
Pandanaceae:	
Pandanus odoratissima Linn. f	
T WHITE ON OUT THE STATE OF THE	
Typhaceae:	
Typha angustata Bory and Chaub	November—February
	100144119
(A) T (B) (A) (A)	
Araceae:	
Amorphophallus campanulatus (Roxb.)	June
Blume. ex Decais.	
Amorphophallus commutatus (Schott.) Engl.	March—July
Colocasia antiquorum Schott	August-September
4.41	
Alismaceae:	
Limnophyton obtusifolium Mig	December—March
•	
Aponogetonaceae:	T 1
Aponogeton netans (Linn) Engl. Krause	July
Eriocaulaceae:	
	NI amanalaman Ni amala
Eriocaulon dianae Fyson D. var longibractea-	November—March
tum Fyson. Eriocaulon cleonaras Fyson	Santamban
Enocuaion cieonaras ryson	September
Cyperaceae:	
Cyperus albomarginatus Mart. and Schrad.	September-October
Cumawa kadhanan Vahi	July—September
Cyperus compactus Retz	September—November
Cyperus compressus Linn	July—September
Cyperus difformis Linn	All the year
Cyperus escaltatus Retz	September-October
Cyperus iria Linn	Entire year
N	

Cyperus kyllingia Endl	July—September
Cyperus leucocephalus Retz	July—September
Cyperus malabaricus (Clke.) Coske	August-October
Cyperus metzii (Hochst.) Matt. and Kukenth	August
Cyperus michelianus (Linn) Link	December-January
Cyperus pygmaeus (Rottb.) Aschers Gasbn.	2 toomso. umidally
Cyperus nutans var Eleusinoides ((Kunth)	June—December
Hainas.	June Beecimeer
Cyperus pangorii Roxb	August—October
Cyperus pumilus Linn	July-September
Cyperus rotundus Linn	July—September
Cyperus squarrosus Linn	
Cyperus tenuiflorus Roxb	September-December
Cyperus triceps Endl	August Dagambar
Eleocharis atropurea Kunth	August—December
Eleocharis spiralis Roxb. R. Br	August
Fimbristylis aestivalis Vahl	December
Fimbristylis bisubumbellata (Fonks) Bud	September—March
Fimbristylis cymosa R. Br	July—January
Fimbristylis dichotoma (L.) Vahl	July-December
Fimbristylis falcata (Vahl.) Kunth	June-July
Fimbristylis ferruginea vahl	October
Fimbristylis littoralis Gandich	September—November
Fimbristylis miliacea (L.) Vahl	October-November
Fimbristylis polythricioides Vahl	September-October
Fimbristylis schoenoides Vahl	August—October
Fimbristylis tenera Roem and Schult	July—October
Fimbristylis tetragona R. B.	AugustSeptember
Fuirena ciliaris (Linn.) Roxb	November—March
Rhynchospora wightiana (Nees) Steud	August-September
Scirpus articulatus Linn	October-November
Scirpus grossus Linn.	October-November
Scirpus lateriflorus	November-December
Scirpus littoralis Schrad var. subulatus	October
chiov.	
Scirpus maritimus Linn	July-September
Scleria tessellata Willd	August-November
var flora (Roxb.) Blatt. and Mc.	
Gramineae:	
Aleuropus lagopoides (Linn) Trin. ex Thy	
	. July-August
	. September—December
Arthraxon lanceolatus (Trin.) Hochst	. September-October
	. October-November
	. August-September
	. July-August
	November
	. October
	October
Cl-l-wi- LLL C	. August—October
	. July
Chloris quinquestetica Bhide	. September
Chloris virgata Sw	. August—September
Coix lachryma-jobi Linn	. September-October
	. August—September
Dactyloctenium aegyptiacum (Linn.) Willo	l. July—October
Danders of animal similar in Daine	August—November
•	-

Decree de la binima de (Limm) Stonf	Mayomban
Desmostachya bipinnata (Linn) Stapf	November November
Digitaria adscendena (H. B. K.) Henr	November
Digitaria alscendens (H. B. K.) Henr	Cantanahan
var. chrysoblephera Henr	September
Digitaria adscendens H. B. K	A
var. marginata Link	October
var. criniformis Henr	T
Digitaria oranularis (Trin) Henr	July-August
Digitaria logiflora (Retz) Pers	July
Digitaria stricta Roth. ex. R. C. S	September
var. stricta.	
Digitaria timorensis Kunth	November
Dimeria stapfina Hubb. ex. Piger	October
Dinlachna fusca (Linn.) Beauv	June—February
Echinochlea colonum (Linn.) Link	July-October
Echinochlea crus-galli (L.) Geauv	October-November
Eleusine indica L. Gaertn	August—January
Elytrphorous spicatus (Willd.) Acamus	November
Eragrostis ciliaris (L.) R. Br	September-October
Eragrostis chariis (Schult) Hitch	September—November
Eragrostis pilosq (L.) Beauv	JulyOctober
Eragrostis temifolia (Zucc.) Trott	September
Eragrostis tenella (Linn) Beauv. ex. R and S	October
Eragroatis tremula (Lamk.) Hochst	October
Eragrostis unioloides (Retz.) Nees ex Staud	July-October
Eninghia managana Unaha	July—September
	October
Heteropogon contortus (Linn.) Beauv	September—January
Iscehne dispar Trin	September—February
Isachne globosa (Thumb.) O. Kunze	August—October
Ischaemus indicum (Houst) Merrill	September
Ischaemum santapaui Bor	October
Iseilema laxum Hack.	September
Melanocenchris jacquemontii Jaub	October
Ophiurus exaltatus (L.) P. Kuntze	May
Oplismenus burmanni (Retz) Beauv	September—November
Oryza rugipogon Linn	September-October
Penicum psi lopodium Trin	July-October
Penicum psilopodium Trin	July—October
var coloratum Hk. f	
Paspalidium flavidum (Retz) A. camus	July—October
Paspalidium arbicularie Forst	August
Paspalum scrobiculatum Linn	July
Pannisetum typhoides (Burm. f.) Stapf	
Pseudanthistiria heteroclita (Roxb) Hk. F.	September-October
1 seudaninismu neteroema (Roko) 11k. 1.	September-October September—November
Pseudanthistiria spineseens (R. Br.) vickary	September—November September
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn.	September—November
Pseudanthistiria spineseens (R. Br.) vickary	September—November September
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn.	September—November September November October—March October
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv.	September—November September November October—March October
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn	September—November September November October—March
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv. Setaria glauca (Linn.) Beauv. Setaria pallida fusca (Schum.) Staff and	September—November September November October—March October July—September
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv. Setaria glauca (Linn.) Beauv. Setaria pallida fusca (Schum.) Staff and Hubb. Setaria tomentosa (Roxb.) Kunth.	September—November September November October—March October July—September July—September August
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv. Setaria glauca (Linn.) Beauv. Setaria pallida fusca (Schum.) Staff and Hubb. Setaria tomentosa (Roxb.) Kunth. Sporobolus capillaris Arniex Mig	September—November September November October—March October July—September July—September
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv. Setaria glauca (Linn.) Beauv. Setaria pallida fusca (Schum.) Staff and Hubb. Setaria tomentosa (Roxb.) Kunth. Sporobolus capillaris Arniex Mig Sporobolus marginatus Hoechst	September—November September November October—March October July—September July—September August August-September July
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv. Setaria glauca (Linn.) Beauv. Setaria pallida fusca (Schum.) Staff and Hubb. Setaria tomentosa (Roxb.) Kunth. Sporobolus capillaris Arniex Mig. Sporobolus marginatus Hoechst. Spinifex littoreus (Burm. f.) Merr.	September—November September November October—March October July—September July—September August August-September July December—February
Pseudanthistiria spineseens (R. Br.) vickary Saccharum spontaneum Linn. Sacciolepis interrupta (Willd. Stapf.) Setaria verticillata Beauv. Setaria glauca (Linn.) Beauv. Setaria pallida fusca (Schum.) Staff and Hubb. Setaria tomentosa (Roxb.) Kunth. Sporobolus capillaris Arniex Mig Sporobolus marginatus Hoechst	September—November September November October—March October July—September July—September August August-September July

FLORA OF KONKAN

Cultivated Grasses of Salsette Island

Name	Fl. season		Locality
(1)	(2)		(3)
Digitaria adscendens H. E. K. Bernard.	Sept.		Madh islands along residences.
Digitaria timorensis (Kunth) Bel.	Nov.		Occasionally found on roadside.
var. blepharophora Henrard			
Isachne dispar Trin. sp. cr. am Icon.	••		Common along water ditches.
Oryza sativa L. (Notulae)	Sept-Oct.		
Paspalum orbiculare Forst	Aug.	••	Along margins of a pond on Madh island.
Setaria pullidifusca (Schum)	July-Sept,	••	Common in open grasslands on hills.
6·4 Grasses of Bombay, Mad Konkan.	dh and other	Surr	ounding Places in
1. Spinifex Squarrosus Linn.	Nov.		On the sandy shores of Konkan, Bandra.
2. Pennisetum orientale Rich	July	••	Konkan.
3. Sataria plicata cooke	Nov.	••	Western side of ghats.
4. Setaria glauca Beauyv	Oct.	• •	Konkan.
 Setaria intermedia Roam: and Schult. 	Aug-Sept., Oc	t.	Konkan in cult- vated fields.
6. Setaria verticillata Beauv.	••		Konkan.
7. Shamaarachis spiniscence Poir.	Sept.	• •	Vangni.
8. Isachne elegans Dalzell	Sept.		N. A.
9. Isachne miliacea Roth	••		Konkan, Lonavala,
10. Axonopus cimicinus Beauv.	•		
11. Oplismenus compositus Beauv.	Nov.	••	At the foot of ghats in Konkan.
12. Opliamenus burmanni Beauv.	Sept-Oct.		Konkan.

13. Panicum flavidum Ratz	Oct.		North and south Konkan.
14. Panicum stagninum Ratz.	Oct.	••	Cultivated fields.
15. Panicum colonum Linn	Oct.		notes.
16. Panicum interruptum Willd.	Oct-Feb.	••	Panvel, Vengurla.
17. Panicum myosuroides R. Dr.	Oct. onwards		Sawantwadi, Alibag.
18. Panicum trypheron Schultz.	Sept.		Malabar Hill.
19. P. proliferum Lam. var. paludosum Stapl.	••		Salsette.
20. P. montanum Roxb	Jan.	••	Khardi (Thane Dist.).
21. P. maximum Jacq	••		Often cultivated as fodder grass, Konkan.
22. P. muticum Forsk.			110
23. Digitaria pedicellaris Prain.	Konkan.		
24. D. Royleana Prain	Dec.		Western ghats
25. Paspalum acrobiculatum:	Oct.		Cultivated
26. Paspalum compactum Roth	Sept.		Konkan
27. P. distichum L	Oct.	••	Sea shore Bombay, Malwan.
28. Eriochloa polystachya: H. B. and K.	Oct.	• •	Bombay.
29. Dimeria woodrowii Stapf	Oct.		Ratnagiri
30. Dimeria gracilis Nees	Dec.		Konkan
31. Imperata arundinaccia Cyrill.	••		Konkan
32. Spodiopogon albidus Bantham.	Oct.	••	Konkan, Ghats, Matheran, Salsette.
33. Saccharum spontaneum Linn.	• •		Karjat
34. S. offisinarum Linn	* *		Cultivated
35. Palunia argentae Trin	Oct-Dec.		
36. Palunia fimbriata Hock	Oct.		Konkan
37. Rottboellia acuminata: Hack.:	Oct.	••	Malwan
38. Rottboellia exaltata Linn.	Nov.		Konkan
39. Apluda varia Hack	Oct-Dec.		Konkan ¹
40. Ischaemum aristatum Linn.	Oct-Dec.		Matunga
41. I. diplopogon H. K. f			Matheran
42. I. semisagittatum Roxb.	Sept-Nov.	••	Konkan
43. I. cilliare Retz	Oct.	••	Salsette, Parel

FLORA	A OF KONKAN		743
44. I. spathiftorum Hook	Sept.		Salsette island
45. Lophopogon tridentatus Hack.	OctDec.	• •	Konkan
46. Apocopis vaginatus Hack	• •		Kalyan
47. Arthraxon inermis Hooker	Oct.		Matheran
48. Arthraxon microphyllus Hochst.	Sept.	٠.	Salsette, Parel
49. Arthraxon jubatus Hack.	Oct.		Konkan
50. Thalepogon elegans Roth	Sept.		Konkan
51. Andropogon kuntzeanus Hack.:	••		Mawal, Konkan
52. Andropogon concanensis: Hook.	Oct.	••	Matheran
53. Andropogon odoratus Da. Lish.:	Oct.	٠.	Khardi
54. Andropogon halepensis Brot.	Dec.		
55. Andropogon armatus Hook	CITED .		
56. Andropogon annulatus Forsk.	Oct.	••	Konkan
57. Andropogon triticeus R. Br.	Dec.		Konkan
58. A. sorghum Brot			Cultivated
59. A. squarrosus Linn	ATTAN		Cultivated as fodder
60. A. schoenanthus Linn			Cultivated for its oil in Konkan.
61. Themeda imberbes T. Cook e.			Cultivated
62. Themeda ciliata Hack	SeptJan.	••	South Konkan, Salsette.
63. T. cymbaria Hack	• •		Konkan common
64. T. triandra Hack	Oct.	••	Common near Raita.
65. Iseilema laxum Hack	NovDec.		Doubtful
66. Coix lachryma Linn			
67. Polytoca cookei Stapf	Sept.	• •	Bombay, Salsette.
68. Arundinella arenacea Mun	Oct.		Ratnagiri
69. A. setosa Trin	• •		Bombay
70. A. tenella Nees	Nov.		Bombay
71. A. pygmaea Hook	Sept.	••	On the crest of the western ghats.
72. A. lawii Hook	• •		Konkan
73. A. capillaris Hook	• •		Panvel
74. A. gigantea Dalz	Oct.		N. A.
75. Thysanolaena agrostis Nees	Jan.	• •	Thane
76. Aristida setacea Retz	• •		Salsette

77.	Garnotia stricta Brongn		••		Neral near Karjat.
78.	Tragus racemosus Scop.	Sept.			Salsette
	Parotis latifolia Ait.		• •		Malwan
80.	Sporobolus minutiflorus Ling.	Oct.		• •	Parel
81.	S. coromondellianus Link	Jan.		• •	Bombay
82.	Eragrostis aspera Nees.		••		Konkan
83.	E. tenella Woodr	Nov.		• •	Konkan
84.	E. interrupta Beauv	Nov.			Vasai, Thane
85.	E. amabilis Wight and Arn.	Sept	Nov.		Parel, Vasai
86.	E. stenophylla Hochst				Malwan
87.	Diplachne fusca Beauv.				Matunga
88.	Gracilea royleana Hook.				Konkan
89.	Cynadon dactylon Pers.	estrata.	••		Grows through- out the State.
9 0.	Chloris incompleta Roth.	(38)	223		Thane
91.	Tripogon pauperculus Stapf.	Sept.		••	Western ghats
92.	T. capillatus Jaub	Sept.		••	Matheran on trace
93.	T. lisboae Stapf.	9784	4.		Karla
94.	T. jacquemontii Stapf		27		Bombay, Matheran
	Eleusine aegyptiaca Desf.	Sept	Nov	••	Ratnagiri
	Eleusine aristata Ehrenb.	mira a	1123 1123		Ratnagiri
	Eleusine coracana Gorni.	यमव ज	41		Wildly cultivated in hilly parts.
	E. dinebra arabica Jacq.	Aug.	T' . 1		T/ =1
	Alytrophorus articulatus Beauv	Nov		••	Kalyan
100.	Aleuropus villosus Trin.	Nov	Dec.	••	Salt marshes and ground near sea Salsette.
101.	Bambusa arundo Willd.		• •		In ghats
102.	Oxytenanthera monostigma Bedd.		••		Konkan ghats
	O. stocksii Munro	Nov.			
104.	Dendrocalamus strictus Nees.		••		Planted in decidu- ous forest.

6.5 Weeds of Bombay and Neighbourhood

These have been studied by G. L. Shah (1964-65). The list given by him is also applicable to many rice fields in other places in Maharashtra, especially where rainfall is heavy or moist soils, drying gradually, but not dry soils on waste lands.

A weed is defined as an unwanted plant in a place, or a plant in wrong Some of them are indigenous and many are exotic having come place. from other lands with men, birds and other animals. Parthenium histerophorus is an example of a weed that has come from South America with food consignments. Seeds of Datura stramonium are found in the wheat that comes from Australia. During the World War I, Amarantus bispinosus has come to India from Mesopotemia with the luggage of soldiers that had gone to Iraq and Middle East. Similarly Acanthospermum hispidum, Xanthium stumairum and other exotic weeds have come to India. All weeds are harmful to man, crops, cattle etc., e. g. Parthenium histerophorus causes allergy in some persons. Some of them are capable of even killing cattle. Some harbour fungi and other organisms which cause diseases in cows, sheep and horses e. g. Ergot on Rye and other grasses. Grasses e. g. Andropogon odoratus, Anthistatia ciliata harbour rice stem-borer insect Schenobius punctifer. It is believed that dry regions of the world possess maximum number of weeds.

Adulteration of food due to weed seeds is quite common. For example, the seeds of Mexican weed Argemone maxicana are often mixed with mustard seeds. It contains a lot of oil which causes symptoms similar to allergy when mixed with edible oils. Many more examples of this kind could be found in any flora. However some of them are potential drugs. A weed which is unwanted in one place may be useful in another place for a biological succession and control. Weeds multiply and spread rapidly producing new races especially those that belong to Compositae. There are two distinctive groups of them: In the first group are the weeds of aquatic plants. Rice is a marshy crop plant. As the water dries and the fields become open, hydrophytic weeds growing in the water logged fields begin to flower from August to September. In the second group the flowering of weeds starts from December and lasts till April (See lists below). Some of the weeds are quite drought resistant. Some of them grow even in salty soils marshes and mud e.g. Cressa cretica, species of Ammania and others

List of such common weeds found in Bombay flora is given below:

Capparidacae

Cleome viscosa Linn.

Violaceae

Hybanthus anneaspermus (L) F. Muel.

Portulacaceae

Portulaca oleracea Linn.

Malvaceae

Abutilon indicum (L) Sw. Sida rhombifolia Var. retusa Masters.

Linaceae

Linum usitatissimum L.

Papilionaceae

Alysicarpus longifolius W. and A. Alysicarpus hamoaus Edgew. Alysicarpus vaginalis (L) DC. Crotolaria linifolia L. f. Mallotus indica Al. Vigna capensis Walp.

Caesalpiniaceae

Cassia tora L.

Molluginaceae

Mollugo pentaphylla L.

Rubiaceae

Anotis foetida Ben and HK. Oldenlandia corymbosa L.

Compositae

Ageratum conyzoides L. Eclipta prostrata L. Eclipta alba (L) Hassk.

Solanaceae

Datura fastuosa L.
Datura fastuosa L. f. var. alba
(Nees.) Clarke.
Physalis minima L. f.
Solanum nigrum L.
Solanum surattanse Burm. f.

Pedaliaceae

Sesamum indicum L.

Acanthaceae

Asteracantha longifolia (L.) Nees. Haplanthus neilghirensis Wt. Peristrophe bicalyculata (Retz) Nees.

Verbenaceae

Phyla nodiflora (L) Green. (Lippia nodiflora A. Mich).

Amaranthaceae

Amaranthus spinosus L. Celosia argentea L. Digera muricata (L) Mart.

Euphorbiaceae

Acalypha ciliata Forsk.
Acalypha indica L.
Euphorbia hirta L.
Kirganelia reticulata (Poir.) Baill.
Phyllanthus fraternus Webster.
Phyllanthus niruri Sanau Hk. f. non-Linn.

Commelinaceae

Commelina diffusa Burm. f.
Commelina hasskarlii Clarke.
Commelina paludosa Bl.
Commelina obliqua Buch-Ham. ex Don. non Vohl.
Commelina suffruticosa Bl.
Cyanotis cristata Schult. f.
Aneiloma nudiflorum R. Br.

Papilionaceae

Lathyrus sativus L.

Pisum sativum L.

Mimosaceae
Mimosa pudica L.

Cucurbitaceae
Citrullus lanatus Thumb.

Convolvulaceae
Ipomoea hederacea Jacq.
Ipomoea carica (L) Sw.

Acanthaceae
Justicia gendarussa Burm. f.

Papaveraceae
Argemone mexicana Linn.

Passifloraceae
Passiflora foetida Linn.

Compositae
Acanthospermum hispidum DC.

Campanulaceae
Laurentia longiflora (L) Petermann.

Lobelia chinensis Lour.

Convolvulaceae

Evolvulus nummularius (L). Linn.

Impomoea triloba Linn.

Solanaceae *Physalis longifolia* Nutt.

Scrophulariaceae Scoparia dulcis Linn.

Verbanaceae
Lantana camara L. var. aculata (L) Moid.

Amaranthaceae
Alternanthera ficoides (L) R. Br.
Alternanthera pungens H. B. K.
Gomphrena celosioides Mart.
G. globosa Linn.

Phytolaccaceae
Rivina humilis Linn.

Piperaceae
Peperomia pellucida H. B. K.

Urticeceae
Pilea microphylla (L.) Liebm.

Pontederiaceae Eichhornia crassipes Solsm.

6.6. Weeds in cultivated fields and drying ponds:-

During rainy season rice is cultivated on a large scale in various parts. Rice seeds contain seeds of Ammania multiflora, Roxb., Jussiea suffruticosa L. and Isachne globosa O. K.

In ponds and ditches Nymphaea nouchali Burm, f. N. stellata Willd. Nymphoides cristatum o. k. N. indicum etc., are common, but Trapa bispinosa is rare.

If the ponds are deep Ottelia alismoides grows after the monsoons. Ditches being temporary, they dry up from November and a new set of weeds begins to appear. They are:

Heliotropium ovalifolium Forsk.
Sphaeranthus indicus Linn.
Crangea maderaspatana Poir,
Bergia ammannioides Roxb.
Coldenia procumbens Linn.
Dentella repens Forst.
Euphorbia thymifolia Linn.
Glinus potoudes Linn.
Hydrolea zeylanica Vahl.
Hygrophila serpillum T. Anderes.
Lobelia alsinoides Lamk.

Oxalidaceae:

Biophytum sensitivum (L.) DC. Oxalis corniculata Linn.

Papilionaceae:

Aeschynomene indica Linn.
Sasbania bispinosą (Jacq) F. and R.
Smithia salsuginea Hance.
Smithia sensitiva Ait.
Zornia diphylla (L) Pers.

Lythraceae:

Ammannia baccifera Linn. Ammania multiflora Roxb. Rotala indica (Willd) Koehne.

Onagraceae:

Ludwigia parviflora Roxb. Jussiaea suffruticosa Linn.

Molluginaceae:

Mollugo hirta Thunb.

Rubiaceae

Dentella repens Forst.
Oldenlandia corymbosa Linn.

Compositae:

Caesulia axillaris Roxb. Fmilia sonchifolia (L) DC. Epaltas divaricata Cass. Gnaphalium indicum Linn. Grangea maderaspatana (L.) Poir. Sphaeranthus indicus Linn.

Lobeliaceae:

Lobelia trigona Roxb.

Gentianaceae:

Conscora diffusa (Vahl) R. Br.

Hydrophyllaceae:

Hydrolea zeylanica (L) Vahl.

Boraginaceae:

Coldenia procumbens Linn. Heliotropium ovalifolium Forsk.

Convoluvulaceae:

Cressa cretica Linn.

Scrophulariaceae:

Donatrium junceum (Roxb.) Buch-Ham, Lindernia ciliata (Colsm) Pennell. Paplidium maritimum (L. F.) Watta,

Lentibulariaceae:

Utricularia reticulata Sm.

Acanthaceae:

Asteracantha longifolia (L.) Nees.
Hygrophila polysperma (Roxb.) T. Anders.
Hygrophila serpyllum (Nees) T. Anders.
Rungia repens (L) Nees.

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Amaranthaceae:

Alternanthera sessilis (L.) DC.

Chenopodiaceae:

Chenopodium album Linn.

Polygonaceae:

Polygonum plebejum R. Br.

Eriocaulaceae:

Eriocaulon dianae Fyson. Eriocaulon eleanoras Fyson.

Cyperaceae:

Cyperus difformis Linn. Fimbristylis diphylla (Retz) Vahl. Fuirena ciliaris Roxb. Scirpus supinus Linn.

Gramineae:

Eragrostis tenella P. Beauv. Isachne globosa (Thunb) O. K. A-127-29-A.

6.7. Weeds along the sea side ponds and sandy shores.

They mostly have Sesuvium portulacastrum, Sueda fruticosa, Pentatropis spiralis, Blumea obliqua, Malachra capitata, Sphaeranthus africanus, Cyperus bulbosus, Hibiscus lobatus. Others are:—

Family Compositae:

Sphaeranthus africans Linn.

Family Boraginaceae:

Heliotropium marifolium Retz. Trichodesma amplexicaule Roth.

Family Convolulaceae:

Ipomoea pes-caprae Sw.

Family Gramineae:

Spinifex littoresus (Bl.) Merrill.

6.8. List of Halophytes of Bombay and Salsette Islands:

Halophytes of Bombay and Salsette Islands are conspicuous in certain areas. They are:—

- 1. Acanthus ilicifolius Linn.
- 2. A. ebracteatus Vahl.
- 3. A. volubilis Wall.
- 4. Acrostichum aureum Linn.
- 5. Aegiceras majus Gnartn.
- 6. Arthochnemum indicum Mog.
- 7. Atriplex stocksii Boiss.
- 8. Avicenia alba Blume.
- 9. A. oficinalis Linn.
- 10. A. nitida See and Mac
- 11. Bruzuiera gymnorhiza Lam.
- 12. Ceriops candolleana Arn.
- 13. Clerodendron inerme Gaertn.
- 14. Cressa cretica Linn.
- 15. Eugenia corymbosa Borg.
- 16. Excoecaria agallocha Linn.
- 17. Kandelia Rheedii W and A.
- 18. Kochia indica Wight.
- 19. Lumnitzera coccinea W and A.
- 20. L. racemosa Willd.
- 21. Rhizophora mucronata Lam.
- 22. Salicornia brachiata Roxb,
- 23. Salsola foetida Deule.
- 24. S. kali Linn.
- 25. Salvadora persica Linn.
- 26. Sesuvium portulaças trum Linn.
- 27. Sonneratia acida Linn.

A-127-29-B.

6.9. Gharapuri or Elephanta Island and its Plants:

Near Bombay Island there are quite a few islands, more important of which are Salsette, Madh and Gharapuri or Elephanta. Elephanta cave is also famous for the Maheshmurti embodying Lord Shiva the Creater, Protector and Destroyer. It can be approached by launch being a few miles to the South East of Bombay proper. It is surrounded by mangroves and has plants not different from those on Bombay Island. Obviously it must have been a part of it and got separated in the past.

The subjoined list will show that they are the same as on main land of Bombay.

Vegetation of Elephanta Island or Gharapuri near Bombay.

(A list of plants)

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Anonaceae:

Anona squamosa

Capparidaceae:

Crataeva sp.
Capparis decidua
=Capparis aphylla

Malvaceae:

B. ceiba L. =Bombax malabaricum Urena lobata Malvastrum sp.

Tiliaceae:

Grewia sp.

Meliaceae:

Melia azadirachta L

Rhamnaceae:

Z. mauritiana Lamq = Zizypus jujuba

Anacardiaceae:

Anacardium occidentale L. Mangifera indica L.

Moringaceae:

Moringa spp.

Papilionaceae

Derris indica (Lamk) Bennett

= Pongamia glabra
Tephrosia purpurea (L.) Pers.
Alysicarpus runosus (Willd) DC
Crotolaria sp.
Vigna trilobata (L.) Verdl.

= Phaseolus trilobus
Sesbania bispinosa (Jacq.) Wight

= Sesbania aculeata
Smithia sp.

Desmodium gangeticum (L.) DC

Caesalpinaceae:

Delonix regia (Hk.) Raf Tamarindus indica L. Cassia tora L. Cassia siamea Lamk

Myrtaceae:

Eucalyptus sp Syzygium cumini (L.) Ske

Lythraceae:

Ammannia sp Ammania hispida Woodfordia fruticosa

Apocynaceae:

Plumaria rubra L.

Compositae:

Tridax procumbens L.
Bidens biternata (Lour) Sherff)
Sphaeranthus indicus L.
Vernonia dioergens

Asclepiadaceae:

Cryptostegia grandiflora Br.

Boraginaceae:

Trichodesmum hispidum

Convolvulaceae:

Ipomoea sp.

Scrophulariaceae:

Sopubia delphinifolia Celsia coromandelina

Acanthaceae:

Hygrophila auriculata (Schum.) Heine = Asteracantha longifolia

Verbenaceae:

Vitex negundo L. Clerodendron inerme (L.) Gaertn. Avicennia alba

Labiatae:

Ocimum plabejum

Amaranthaceae:

Achyranthus aspera L.

Euphorbiaceae:

Euphorbia hirta L. Jatropha curcas L.

Orchidaceae:

Vanda roxburghii Br.

Dioscoreae:

Dioscorea bulbifera L.

Palmae:

Cocos nucifera L. Borasus flabeilifer L. Caryota urens

Eriocaulaceae:

Eriocaulon sp

Cyperaceae:

Fimbristylis cymosa R. Br. F. dichotoma (L.) Vahl.

Graminae:

Themeda fruandra Lachemum sp. Cynadon dactylon L.

7. FLORISTICS OF THANE DISTRICT

Thane district is partly maritime and partly hilly. The monsoon ephemeral flora occurs on the hill tops and slopes. It consists of grasses and Impatians balsamina, Polygala chinensis, Linum mysorensis, Clitoria biflora, Crotolaria sp., Pimpinella hyeneana, Bidens biturnata, Tridex procumbens, Buchnera hispida, Rhamphicarpa longiflora Sopubia delphinifolia, Torenia indica, Nauracanthus sphaerostachya, Celosia argentia, Euphorbia sp. Phyllanthus niruri etc.

Southern Tropical semi-evergreen forests.—These occur in patches between 550-1400 m altitude at Murbad, Tokawada and Vashala ranges and on the slopes of Tungar hill. It generally occurs along the ghats. On the lower slopes they are mixed with deciduous species such as Schleichera oleosa, Terminalia crenulata, T. chebula, Ixora brachiata, Carvia callosa, Bridelia squamosa. On the hills Memecylon umbellatum occurs in pure patches. Shrubs of Eleagnas conferta, Acacia torta, Colebrokia oppositifolia, Cappris rotundifolia, Ventilago bombaiensis, Carissa congesta occur on lower slopes. There is also a herbacious layer. During rainy season in open rocky situation consisting of Smithia purpurea, Smithia bigemina, Heracleum sp. Cynotis tuberosa, Habenaria grandiflora, Leucas sp. besides Swertia minor, Orosera indica, Exacum pedunculatum, some grasses and Cyperus pumilum, Eriocaulon dianas. There is also a compact colony of Centratherum phyllodae and C. tenue. In ponds typical aquatic vegetation is seen as elsewhere with the addition of aquatic tern Ceratopteris thallictroides. There are many weeds in open unfertile and shallow lands.

In general the vegetation in the five districts of Konkan is more or less similar except in the southernmost part of Sindhudurg district in Amboli ghat and Phonda ghat belt. The change in vegetation north to south is gradual. The slopes of northern part are covered with deciduous forests along the lower slopes. They gradually merge into semi-evergreen torest in the southern part. Giant trees of real evergreen forest like Hydnocarpus laurifolius, Calophyllum elatum, Hopea wightiana, Canarium strictum, Mammea surihega do not occur here.

Analysis of Angiosperm families in Thane:

Bilore (1974) who worked on Thane flora furnishes first-hand information as noted below. He found that there are 74% dicots and 16.34% monocots, spread over 105 families of angiosperms, 572 genera and 989

species including naturalised and exotic ones. The ratio of dicots to monocots is 31·1. The principal families are:

Familie	s		Genera	Taxa
Poaceae			69	118
Fabaceae	. ,	• •	83	86
Asteraceae			31	52
Euphorbiaceae	• 3		21	39
Acanthaceae			22	36
Rubiaceae			18	29
Convolvulaceae			11	29
Orchidaceae			14	28
Scrophulariaceae			15	25
Lamiaceae	٠,		15	23
Asclepiadaceae			14	28
Verbenaceae			9	16
Malvaceae		estreto.	10	15
Gentianaceae	5	43.5	27	14
Commelinaceae	ěN.		4	14
Boraginaceae	183		9	13

Dominant genera are 22, having 6 or more than 6 species. They are as under:—

Cyperus		of the		(21)
Crotolaria			177	(16)
Ipomo ea		licinal C		(15)
<i>Euphorbia</i>		The state of		11+2 cultivated
Ficus		સવ્યમવ	পাধল	(10)
Fimbristylis			• •	(10)
Isachnemum		••	••	(10)
Blumea	• •	• •	• •	(9)
Desmodium				(8)
Eragrostis		• •		(8 each)
Indigofera				(7)
Smithia		• •		(7)
Commelina		• •	• •	(7)
Eriocaulon				(7)
Cassia		• •		(6)
Lindernia		• •		(6)
Dioscorea		• •	• •	(6)
Arthraxon		• •		(6)
Bothriochloa				(6)
Acacia		• •		(5)
Sida		• •		(5)
Scirpus				(5)

8- THERMAL SPRINGS OF VAJRESHWARI AND ALGAE THEREIN

They are a novel feature of these districts. The hot water springs have their own flora, almost entirely composed of Algae. They belong mainly to Myxophyceae. They are of considerable interest in as much as they can grow in water having a range of temperature 60-70 °C. They have attracted attention of geologists since long (Boest G, 1891, On vulcanoes in India. Trans. Bom. Geo. Soc. Vol. 10. Oldham T. 1882; The thermal springs of India. Mem. Geol. Surp. India Vol. 19). Oldham found not less than 301 such groups of hot springs in India; in Konkan alone 23. They not only occur at Unabdev in district Jalgaon and in Konkan, but also in south coast and in Gujarat at Unai. Generally the temperature of water depends upon the depth from which the springs arise. Out of the 23 springs in Konkan some occur nearby Vaireshwari near Bombay. They have been studied by Professor Ella Gonzalves (1947). They are 77 km. from Bombay. They occur on either side of river Tansa. Sometimes they occur in the river bed itself. There are 3-4 groups of them having more than 20 springs. The temperature of the largest spring here was 57.0 °C. It occurs in a circular pool, 6 feet in diameter and 3-4 feet deep. Clear water gushes out from it nearly 30 gallons per minute. The underlying rock is basalt and laterite, often badly decomposed due to hot water. A number of algae occur here. Anabaena grows by sides of the pool having a temperature 57.5°C. They never bear spores. *Phormidium africanum* thrives at 55°C. It grows between 40°C and 55°C. On the other hand *Phormidium* orientale occurs between 38-49°C. Plectonema gracillimum occurs at 49°C but not at lower temperature. Oscillatoria jasoruensis between 40-49°C. Common algae here are the colonial Oscillatoria and Aphanotheca thermalis. They grow between 47-49°C. Colonies of these may be small or large. Lyngbya putealis occurs between 40-45°C. At lower temperatures also some other algae are found here. They are Spirulina subsalse Derst, Oscillatoria proboscides Gomb, At 38°C between 34-36°C Scytonema tolypothrixhoides Lyngbya aestuarii Lieb. forma spectabilis Comb., Gleocapsa granosa (Burk.) Kutz, Anabaena orientalis Dixit, Aulosira bombaensis and two diatom sp. Of these Gleocapsa granosa only forms spores, like Nitzschea thermalis and Thopaloidia jibberula . Of these only Phormidium africanum common in almost every spring or in the overflowing water having a The others are Phormidium orientale and temperature 40-54°C. Cscillatoria jasoruensis.

Probably the *Phormidium orientale* and *Aphanocapsa thermalis* are real thermal forms because all others are also found in cold waters, but not these two algae.

Systematic enumeration of the thermal species of Cynophyceae is given below.

I. Order—Chroococcales:

Family—Chroococcaceae:

- 1. Aphanotheca thermalis Brug. occurs with Phormidum africanum
- 2. Gleocapsa granosa occurs at 34°C on the walls of a tank with Aulosira bombayensis,

II. Hormogoniales:

Family—Microchaetaceae

3. Aulosira bombayensis Gonz. on the walls of the tanks with water at 34°C.

Family-Scytonemaceae:

- 4. Plectonema gracillimum in the tank of the temple of Vajreshwari growing at the temperature 29°C.
- 5. Scytonema tolypothrichoides in overflow waters at 36°C.

Family-Nostocaceae:

- 6. Anabaena species.—This grows in the hottest spring at 57.5°C
- 7. Anabaena orientalis Dixit growing in overflow water at 34°C.

Family-Oscillatoriaceae .

- 8. Spirulina subcetosa grows with Oscillatoria proboscides at 58°C temperature in overflow water,
- 9. Oscillatoria proboscides in the overflow at 38°C.
- 10. Oscillatoria jasorvensis in the overflow at 40-49°C.
- 11. Phormidium africanum in overflow of various spring at 40-54°C temperature.
- 12. Phormidium orientale in overflow water between 38.49°C.
- 13. Lyngbya aestuarii in overflow between 34-36°C.
- 14. Lyngbya putealis in temple tank and overflow at 40-45°C.

III. Order—Pennales, Bacillariophyta (Diatomaceae) Family—Epithemaceae :

- 15. Rhopalidia gibberula in overflow spring at 40°C.
- 16. Nitzschiela thermelis in overflow water of spring above 40°C.

[For details see Gonzalves E, 1947—Jour. Univ. Bombay Vol. 16(3): 22—27].

The thermal springs at Mahad and other places have not been investigated.

सत्यमव जयत

Thermal Algae

Name

Locality

Chroococcaceae

- 1 Gloeocapsa granosa (Bork) ... Found in hot water springs at Vajreshwari growing at a temperature 34°C.
- Aphanocapsa thermalis (Kutz) .. Vajreshwari. Prugg.

Hyellaceae

- 3 Spirulina subsalsa Gerst ex Vajreshwari.
- 4 Oscillatoria chalybea (Nestena) Bombay, Vajreshwari. Gomont.
- 5 Phormidium africanum .. at 40 to 50°C. Vajreshwari
- 6. Lingbya putealis Monl. ex Gomont at 40-45°C at Vajreshwari.
- 7 Anabaena orientalis Dixit .. Vajreshwari.
- 8 A. burlayensis Gonzalves .. Vajreshwari.
- 9 Plectonema gracillimum Zopf Vajreshwari. Hansgirg.

9. Grasses and Fodder Plants of thane and other places in Maharashtra

Grasslands constitute a very distinctive feature of Thane district and some other places in Maharashtra like Talegaon or Katraj. The principal areas conserved are in Thane, Pune, Khandesh and Melghat. They generally grow together with wild legumes such as Crotolaria linifolia L, Crotolaria triguetra Dalz, C. filipes Benth. Smithia sensitivium Ait, Alysicarpus lagenaris DC, Indigofera tinctoria L, Heylandia latebrosa DC. Together they make excellent pastures. The main species of grass are Ischaemum ciliara Retz, Heteropogon contortus L., Themeda quadrivalvaris Ok. Pseudanthis sp., Arundinella tenella, Dichanthium annulatum Stapf, Eulalia fibriata Sl. and Mc. Occasionally seen are Panicum antidotala, Pennisetum species. Iseilema wightii, Cloria monolyana, Tricholaena repens, Penicum variagatum, Eragrostis superba, Eragrostis curvila, Pennisetum polystachyon, Ischaemum sulcatum, I. laxum, Andropogon monticola, A. pertusus, Dicanthium curiosum.

In Thane they extend from Raita to Palghar, Umbergaon including Dahanu and Kosbad. A lot of work on their agronomy, improvement, regeneration of grasslands, has been done in Maharashtra.

On the escarpments of Sahyadri ranges to the west in Konkan, especially in the ghat sections, only grasses grow. In Khandesh they grow around Dhule. The rainfall at these four centres of grasslands is not the same nor are the soils. Naturally grass species in each of these areas are different. Many new species such as Gayana grass, Para grass 'Gaja-Raj' have been introduced. A booklet 'Review of Research on Grass Lands: Forage and Fodder Crops' is published by the Agricultural Department of Maharashtra, which may be consulted for details.

A list of grasses in Thane are given below :---

- 9.1. Wild Grasses of Thane:
 - I. Dry stock farm, Site I, Palghar:

Perennial grasses:

Dichanthium caricosum nperata cylindrica schaemum indicum I. pilosum Iseilema prostratum Sorghum halipense Themeda triandra.

Annual grasses:

Apluda mutica
Arundinella metzii
A. pumila
Chionochne koenigii
Coix lacrymajobi
Pseudanthistrics hispida
Setaria glauca
Themeda quadrifolio
Themeda triandra.

Herbs-

Alysicarpus longifolius Atylosia scaraboeoides Crotolaria sp. Desmodium diffusum Hibiscus sp. Indigofera linifolia Justicia betonica Phaseolus sp. Sesbania bispinosa

Shrubs and trees in grass-

Acacia catechu Butea monosperma Ziyzphus sp.

II. Dry stock Farm, Site II, Palghar:

Perennial grasses-

Dichanthium annulatum D. caricosum Ischaemum indicum I. pilosum Iseilema prostratum Ophiurus exaltatus

Annual grasses— Arundinella metzii A. pumila

Herbs---

Crotolaria sp. Desmodium diffusum Indigofera hendecaphylla Jacq.

Shrubs---

Butea monosperma Carissa carandus Zizyphus mauritiana

III. At Kamarabagh, Palghar:

Perennial grasses-

Dichanthium annulalum: D. caricosum Ischaemum indicum Iseilema laxum

Annual grasses-

Apluda mutica Brachiaris ramosa Eragrostis tanella

Herbs-

Corchorus sp. Crotolaria sp. Desmodium diffusum Euphorbia hirta

Shrubs and trees-

Bauhinia sp. Zizyphus sp.

IV. In Reserved Forest. North Thane Division, Palghar:

Perennial grasses-

Ischaemum indicum Tripopogon ramosissimus

Annual grasses--

Arundinella pumila Eragrostis diarrhana Ischaemum semisagittatum Pseudanthistiria umbellata Themeda quardivalvia

Herbs-

Cassia tora Crotolaria sp. Mucuna sp.

Shrubs and trees— Tectona grandis

9.2. Cultivated grasses of Thane for fodder and other purposes

Out of the above list the following grasses are cultivated for fodder and other purposes. Their use is shown against their names:—

Do.

- 1. Cymbopogon martianii ... Grown for fodder.
- 2. Cynodon dactylon
- 3. Echinochlos colonum ... Do.
- 4. Eleusine coracana Do.
- 5. Ischaemum indicum ... Do.
- 6. Ischaemum tumidum stafex .. Do.
- 7. Pseudanthistiris heterociliata .. The best fodder grass.
- 8. Sacciclepis interrupta .. For fodder.
- 9. Neyrandis arundinacea Do.
- 10. Arundo donax Do.
- 11. Oryza sativa Grown as paddy.
- 12. Panicum sumatranse ... Grown for grain used by Adivasis as food.
- 13. Eulaliopsis birawta Used in paper industry.

9.3. Flora of Ulhasnagar

Ulhasnagar is situated about 58 km. away from Bombay. It is situated on Waldhuni and Ulhas rivers lying 19°.12' N. Lat. and 73° East Long. near the foot of Haji Malang range of Sahyadris. It is only about 9 metres above the sea level, having 2,540 mm. of rainfall, mostly in the months June and September. The maximum temperature is 31°C. The soil is lateritic or derived from gravel and hard sandstone. In monsoon annual herbs grow on them and a few liverworts like Riccia, Cyathodium Anthoceros and Notothylas species. A species of Selaginella miniatospora, Marsilea quadrifolia and two species of Adiantum are

Tiliacaeae:

Burseraceae:

Chorchorus olitorius L.

Garuga pinnata Roxb.

common. Ceratopteris thalictoroides grows in marshy places. About 160 species belonging to 57 families have been recorded by Dr. G. T. Dabhade of Thane College. Noteworthy among them are Thespesia paopulnea, Garuga pinnata, Zizyphus rugosa, Woodordia fruticosa, Jussiaea suffruticosa Dentella repens, Sphaeranthus indicus Clerodendron phlomoides, Aeridis crospun (an orchid) and the three usual palms Phoenix sylvestris, Borassus flabellifer and Cocos nucifera. Malachra capitata is rampant in marshes and a few mangroves. The flora appears to be a mixture of marsh and dry species.

Locality Name Anonaceae: Anona squamosa L. Polyalthia longifolia Benth. and Hook. Menispermaceae: Cocculus villosus DC Waldhuni river bank. Papaveraceae: Argemone mexicana L. Cruciferae: Brassica nigra Koch. Near Ulhasnagar railway station. Waldhuni river bank and Ulhas-Brassica oleracea L. nagar College campus. Waldhuni river bank and Ulhas-Raphanus sativus L. nagar College campus. Capparidaceae: Waldhuni river bank. Čleome viscosa L ... Portulacaceae: Waldhuni river bank. Portulaça oleracea L. Malvaceae: Hibiscus rosa-siensis L. Hibiscus esculantus L. Vithalwadi Rlv. station. Sida acuta Burm. f. Vithalwadi Rly, station. Sida cordifolia Lam. Ulhasnagar Rly. station. Sida veronicifolia Lam. Sida rhombifolia L. Vithalwadi Rly. station. Malachra capitata L. Waldhuni river bank, Vithalwadi Rly. station, Ulhasnagar Rly. station. Waldhuni river bank, Urena lobata L. Vithalwadi Rly. station, Ulhasnagar Rly, station, Thespesia populnea Soland Ulhasnagar College campus. Bombaceceae: Bombax ceiba L. Starculiaceae: Gauzuma tomentosa H. B. and K. Ulhasnagar Rly, station.

Vithalwadi Rly. station.

Ulhasnagar railway station.

Waldhuni river bank.

Name Locality Meliaceae: Azadirachta indica Juas. Rhamnaceae: *Zizyphus jujuba* Lam. Zizyphus oenoplia Mill.\ Zizyphus rugosa Lam. Waldhuni river bank. Anacardiaceae: Mangifera indica L. Moringaceae: Moringa pterygosperma Gaert. Papilionaceae: Crotolaria pusilla Heyne ... Vithalwadi Rly. station. Indigofera linifolia Retz. ... Vithalwadi Rly. station. . . Tephrosia tinctoria Pers. ... Waldhuni river bank. . . Smithia bigemina Dalz. ... Vithalwadi Rly. station. Smithia sensitiva Ait. Waldhuni river bank. Aeschvomene indica L. Waldhuni river bank. Alysicarpus vaginalis DC. Vithalwadi railway station, 1005 Ulhasnagar railway station. Desmodium triflorum DC. Abrus precatorius L. Waldhuni river bank. Phaseolus mungo L. Ulhasnagar railway station. Waldhuni river. Pongamia pinnata Pierre Caesalpinaceae: Caesalpinia pulcherrima Swartz. Tamarindus indica L. Mimosoideae: Mimosa pudica L. Ulhasnagar College campus, Cassia tora Bak. ... Vithalwadi railway station, Acacia arabica Willd. Vithalwadi Rly, station. Acacia catechu Willd. Crassulaceae: Ulhasnagar College campus. Bryophyllum calycinum Salisb. Myrtaceae: *Eugenia jambolana* Lamk, Lvthraceae: Woodfordia fruticosa Salisb. Ulhasnagar railway station. Lawsonia alba Lamk. Ageratum conyzoides L. Waldhuni river. Cyathocline purpurea (Don) D. Kuze. Vithalwadi railway station, Blumea wightiana DC. Sphaeranthus indicus L. Gnaphalium luteoalbum L. Caesulia axillaris Roxb. ... Vithalwadi railway station.

Xanthium strumarium L. ...

Blainvillea latifolia (Linn.). DC.

Eclipta alba Hassk.

Tridex procumbans L. Launea nudicaulis Hook.

Name	Locality
Oleaceae: Jasminum grandiflorum L.	
Apocynaceae: Nerium odorum Sol. Thevetia nerifolia Juss.	
Asclepiadaceae: Calotropis gigantea Br Cryptolepis buchananii R. Anders	Ulhasnagar railway station.
Gentianaceae: Canscora diffusa R. Br	Ulhasnagar railway station.
Boraginaceae: Trichodesma indicum R. Br.	Ulhasnagar railway station.
Cordia dichotoma Forsst. Heliotropium indicum L	Waldhuni river bank.
Convolvulaceae: Ipomoea campanulata L Ipomoea aquatica Forsk Quamoclit vulgaris Chois Quamoclit phoenicea Chois	Ulhasnagar College campus. Waldhuni river bank. Ulhasnagar railway station. Ulhasnagar College campus.
Cuscutaceae: Cuscuta reflexa Roxb.	
Solanaceae: Solanum xanthocarpum Schd and Wendl. Datura fastuosa L Solanum nigrum L	
Physalis minima L	Waldhuni river bank.
Lindenbergia urticaefolia Link Bonnaya oppositifolia Spreng	
Pedaliaceae :	1.41421
Sesamum indicum L. Martynia diandra Glox	T 711
Acanthaceae:	
Asteracantha longifolia Nees	•
Lepidagathis cristata Willd	. Vithalwadi railway station,
Justicia simplex Don	311 114
Adhatoda vasica Nees	
Peristrophe bicalyculata Nees .	. Ulhasnagar and Vithalwadi railway stations.
Rungia pactinata Clarke	. Waldhuni river bank. Vithalwadi railway station.
Vitex negundo L	·
Labiatae : Anisometes cyata Br	. Ulhasnagar railway station.

Name

Locality

Nyctaginaceae:

Boerhaavia diffusa L.

Bougainvillaea spectabilis Willd.

Amaranthaceae:

Amaranthus paniculatus L.

Vithalwadi railway station. Amaranthus viridis L. . .

Cclosia argentea L.

Achyranthes aspera L.

Ulhasnagar. Aerua scandena Wall.

Aerua lanata Juss.

Gomphrena globosa L.

Alternathera sessilia R. Sr.

Chenopodiaceae:

Chenopodium album L.

Polygonaceae: Polygonum glabrum Willd.

Loranthaceae:

Dandropthoe falcata Kurz.

Euphorbiaceae:

Euphorbia nerifolia Dalz.

Phyllanthus niruri L.

Euphorbia hirta L. Phyllanthus reticulatus Poir.

Moraceae:

Ficus glomerata Roxb Ficus religiosa L. Ficus bengalensis L.

Casuar naceae:

Casuarina equisetifolia Forst.

Hydrocharitaceae:

Hydrilla verticillata Presl.

Orchidaceae:

Aerides crispum Lindl.

Amaryllidaceae:

Agave americana L.

Liliaceae:

Aloe vera L.

Pontaderiaceae:

Monochoria hasteafolia Prasl.

Commelinaceae:

Commelina benghalensis L.

Commelina forskalii Vehl.

Cyanotis fasciculata Schultz

Aneilema spiratum Br.

Palmae:

Phoenix svlvestris Roxb. Borassus flabellifer L. Cocos nucifera L.

Waldhuni river bank.

Waldhuni river bank.

Waldhuni river bank. Vithalwadi railway station.

Waldhuni river bank. Vithalwadi railway station. Waldhuni river bank.

Waldhuni river bank. Ulhasnagar railway station. Ulhasnagar railway station.

Waldhuni river bank.

Ulhasnagar railway station.

Ulhasnagar railway station.

Name Locality

Pandanaceae:

Pandanus odoratissimus L.

Cyparaceae:

Cyperus rotundus L. .. Waldhuni river bank.

Gramineae:

Saccharum officinarum L. .. Waldhuni river bank.

10. FLORA OF RAIGAD DISTRICT

Raigad district is adjacent to Thane, Greater Bombay and Ratnagiri. The Fitzgerald ghat joins it to Mahabaleshwar via Poladpur. Kolaba, now named Raigad, is a maritime district with Alibag as its headquarters. It is a rugged country not much above the M. S. L. Long ranges of Sahyadri run through it and are densely covered with scruby vegetation and low dry deciduous trees. Parts at the foot of Sahyadris on the western side such as Pali, Mahad, Poladpur, Khopoli have deciduous forests. The beautiful hill station of Matheran is in Raigad district. Much of the vegetation on the sea side contains many groves of coconut and areca palms. Borassus is there but not common. No authoritative district flora has yet been written, but from what is known so far it is of the same type of flora as in Thane. Only flora of Matheran and the hill fort of Raigad are known and they give idea of vegetation to the west of Sahyadris in this district. It contains a few moist deciduous species like Garcinia indica which are confined to the hill tops. The portion near Alibag and Shrivardhan presents a park-like appearance due to intensive cultivation and many wadis full of coconut and Areca palms.

Flora of Matheran and Raigad fort has been worked out by Cooke (1887), Birdwood (1886) and of Raigad fort by Vartak (1966). The Matheran flora represents a typical hill flora of low altitude in Sahyadri ranges and of low hills in Konkan facing Arabian sea to the west. Both are significant promontaries in Raigad district and have characteristic vegetation. Raigad's vegetation is partly unlike that of other hill forts like Sinhgad, Purandar and Torna which lie on the leeword or Desh side of Sahyadris. In this connection, the flora of Sinhgad, Torna and Purandar may be compared with it, and contrast noted.

10.1. Flora of Matheran:

One of the special features of Western Ghats is the disconnected upland plateaus on the peaks of Sahyadris. This has given rise to a number of hill stations on their highest positions. Matheran is one of them and is close to Bombay and Kalyan. The highest point of Matheran is about 2500' above the sea level. It has a number of plants common to the ghat forests, on its topmost parts. Some of them are found only at Matheran. Cooke mentions that the flowering plants including a few grasses found here, are 170. About 130 plants of Mahabaleshwar do not occur on the Matheran plateau. Not less than seven species of Strobilanthes occur here. The vegetation is of the monsoon deciduous type in which some species of Garcinia, 24 species of ferns and 9 species of mosses grow at Matheran. Bushes of Ligustrum nilghirense, Salix tetrasperma found at Mahabaleshwar are also found at Matheran. Golchidion species and Flacourtia montana, Kydia calycina, Artocarpus insignis are pretty common. On southern slopes we get some thorny bushes, but on the eastern slopes down the valley near Ramghat, there is a fairly thick forest in which some tall creepers such as Celastrus

paniculatus and a number of ferns grow and also at its base. There is no dense vegetation at Matheran, because the flora is mostly on the western and northern side where the escarpment of rocks is 60 to 90 metres straight down. In the vegetation on the western side of the hill there are mostly grasses.

The important Matheran flora lies in the forest on the crest of the hill on the western side of Sahyadris. It has some plants which are not to be seen elsewhere. That is why a number of plants are localised and endemic. They possibly illustrate the process that must have been at work for a long time in the forests of Maharashtra. The only other similar situation is met with in the flora of Raigad forest lying to the west of Sahyadris.

The following two lists give plants found at Matheran. They are old but have not been succeeded by better and recent ones.

10.2. List of plants of Matheran after Birdwood (1886) and Cooke (1887)

Species	Flowering season
Ranunculaceae: Clematis gouriana Roxb	October-November
Dilleniaceae: Dillenia pentagyna Roxb	March-April
Menispermaceae: Cocculus macrocarpus Wight	February-March
Papavaraceae: Argcmone mexicana Linn	All the year
Capparidaceae: Capparis pedunculosa Wall	March
Guttiferae: Garcinia indica Choisy G. spicata Hook var macrantha	NovemberFebruary December-January
Malvaceae: Ancistrocladus heyneanus Wall Hibiscus hirtus Linn	October—January October—December October
Sterculiaceae: Sterculia urens Roxb	December—February
Tiliaceae: Grewia polyantha Roxb Erinocarpus nimmonii Grah Corchorus acutangulatus Lam	September—November August-September September
Malphigiaceae: Aspidopterys cordata Jun	September—November
Geraniaceae: Impatiens acaulis Arn	September—November
Rutaceae: Murraya exotica Linn	June—October
Bursaraceae: Canarium strictum Roxb	February—April

A-127-30-A.

Species	Flowering season
Meliaceae: Cedrela toona Roxb	January
Celastraceae: Celastrus paniculata Willd Gymnosporia pubenula Laws Hippocratea grahamii Wight	November—February April—June January—April
Rhamnaceae: Zizyphus xylopyrus Willd	outent, rapas
Sapindaceae: Hemigyrosa canescens Thwaies Schleichera trijuqa Willd. Sapindus laurifolius Vahl	February—May February—May October—December
Leguminaceae: Smithia sensitiva Act	September-October August—October
D. triquetrum DC. Shuteria vestita Wight and Arn. Erythrina stricta Roxb.	September—December October February—May
Atylosia lineata Wight	October—December November—February November—January
Dalbergia torta Graham	June February—March April-May
Caesalpineae: Mezoneuron cucullatum Wight Bauhinia foveolata Dalz	September—October September—October
Mimoseae: Acacia concinna DC. Albizzia stipulata Boivin A. amara Boivin	March—July April—June April—June
Crassulaceae : Bryophyllum calycinum Salirb	January
Rhizophoraceae: Carallia integerima DC. Calycopteris floribunda Lamk. Anogeissus latifolia Wall.	March—May
Myrtaceae: Careya arborea Roxb	March-April
Lythraceae: Lagerstroemia parviflora Roxb	June
Onagroceae: Ludwigia parviflora Roxb	May-June
Samydaceae: Casearia graveolens Dalz	August—January
Cucurbitaceae: Dicoelospermum ritchiei C. B. darke	July-September
Umlelliferae: Hydrocotyle asiatica Linn. Peucedanum grande C. B. clacke	May—November July

A-127-30-B.

Species

Flowering season

Rubiaceae:		
Hymenodictyon excelsum Wall.	٠.	June—August
H. obovatum Wall		July-September
Anotis rheedei Banth		July
Mussaenda frondosa Linn		JulyOctober
Randia dumetorum Lamk		March-June
=Xeromphis spinosa		
Vongueria spinosa Roxb	٠.	January—April
Ixora parviflora Vahl		January—April
Pavetta indica Linn		March—May
Phispidula Wightii	• •	May
Compositeae:		
Vernonia cinerea Len	٠.	January-February
Elephantopus scalees Linn		September—November
Blumea wrightiana DC		December-January
Blumea belangariana DC		December—March
B. malcolnii Hook		November—February
Genaphelium indicum Linn		December—March
Vicoa cernua Dalz		November—February
Xanthium strumarium Linn	Ð.	January-February
Campanulaceae:	375	2
Lobelia nicotianaefolia Heyne	ale:	November—March
Wahlenbergia gracilis Schrad.		December—February
DSMB093		69
Sapotaceae: Sideroxylon tomentosum Roxb.	586	October—January
Bassia latifolia Roxb	117	· January—April
Mimusops elengi Linn	6 N. Y	January—April January —March
47° 45° W	BM.	January — March
Ebenaceae:	112	January Pahruary
Diospyros sylvatica Roxb	24	January-February
Oleaceae:	Silli	Man Man
Jasminum malabarioum Wight.	जय	May-May
Olea dioica Roxb	• •	January—April
Apocynaceae:		
Alstonia scholaris R. Br		December—March
Holarrhena antidysenterica		February—June
Ervatamia heyneana T. cooke		March-April
Wrightia tinctoria R. Br	٠.	
Anodendron paniculatum DC		December—March
Asdepiadaceae:		
Calotropis gigantea R. Br		February—July
Holostema rheedianum Spreng		July-August
Loganiaceae:		
Fagraca obovata a Wall		July
Strychnos colubrina Linn	• •	. October-January
Conscora diffusa R. Br	•	. October—January
**		
	• •	
Boraginaceae:	•	·
Cordia myxa Linn	•	, March—April
Cordia myxa Linn Ehrelia laevia Roxb	•	. March—April
Cordia myxa Linn Ehrelia laevia Roxb Convolvulaceae:	•	. March—April . January—June
Cordia myxa Linn Ehrelia laevia Roxb Convolvulaceae ; Cuscuta reflerxa Roxb	•	. March—April . January—June . January-February
Cordia myxa Linn Ehrelia laevia Roxb Convolvulaceae; Cuscuta reflerxa Roxb Porana malabarica C. U. clarke	•	. March—April . January—June . January-February . October
Cordia myxa Linn Ehrelia laevia Roxb Convolvulaceae ; Cuscuta reflerxa Roxb		. March—April . January—June . January-February

Species			Flowering season
Argereia sericea Dalz			September-October
Lettsomia setosa Roxb. Scrophularicaceae:	••	• •	September—December
Limnophila racemosa Benth	• •		November—January
L. qatripleides R. Br			November—January
Striga orobanchioides Benth			October-November
Rhamphicarpa longiflora Ber	ith.		October-November
Sopubia delphinifolia G. Dor	1.		August—October
Centranthera hispida R. Br.	• •		September-October
Lentibulariaceae: Artricularia flexuosa Vahl.	• • •		November
Bignoniaceae:			
Heterophragma roxbrughii D Acanthaceae:	C.	••	February—April
Daedalacanthus roseus T. An	dere		November Jones
D. purpuras cens T. Anders	ideis	• •	November-January November-January
Strobilanthes heyneanus Nee	· ·	• •	October—December
S. perfoliatus T. Anders	· · ·	• •	Octoo vi December
Calacanthus dalz elliana T. A	\nders	•••	October-December
Haplanthus verticillaris Nees		• •	December
Barleria prionitis Linn.		52	October-January
B. lauri T. Anders.	100	976	October
Bistigosa Willd.			November—December
Asystasia violacea Dalz.		70.9	November
Lepidagathis cuspidatus Nees		89	March
Rungia parviflora Nees.	A intel	T.	November-February
Dicleptera zeylanica Nees.	31 Y F.W	VX.	December-March
Echolium linneanum Kurz.	50 M	822	October—January
Justicia betonica Linn.		530	October—December
J. trinervis Vahl		554	October-January
Verbenaceae: Callicarpa lanata Linn	यमेव ज	धने यने	DecemberApril
Labiateae:			*
Pogostemon purpurasens Dala	z.		October—January
Anisomeles heyneana Benth.			October-November
A. ovata R. Br	• •		August—October
Leucas stelligera wall			November
Piperaceae:			
Piper trichostachyon Can.			
P. hookeria Mig	• •		April—September
Lauraceae:			T. T
Machilus macrantha Nees.			December-March
Alseodaphne semicarpifolia N	ees.		July—December
Actinodaphne hookeri Meissn		• •	November November
Elaeagnaceae:		••	
<i>Elaeagnus latifolia</i> Linn.	• •	• •	November—January
Loranthaceae:			
Loranthus cuneatus Heyne			April-May
Loranthus laginiflorus wight			April-May
L. capitellatus Wrght	• •		February—May
Euphorbraceae:			
Bridelea hamiltomiana Wall.			August-November
Phyllanthus emblica Linn.	• •	• •	March-May

Species			Flowering Season
P. wrinaria Linn. Croton reticulatus Heyne Dimorphocalyx laurianus Hool Mallotus lamii Mudl. Macaranga tomentosa Wight Tragia involucrata Linn.		•••	August October—January March—October October—January January—March November-December
Urticaceae: Trema orientalis Blume Fleurya interrupta Gand. Lecanthus wightii Wedl. Ficus arnottiana Mrg	•	••	Throughout year August September-October February—April
Burmannia caelestis Doc.	. •		September
Orchidaceae: Dendrobium barbatulum Lindl Thunia venosa Rolfe Platanthera susannae Lindl. Habenaria plantaginea Lindl	econs		April-May July-August September March-April
Commlinaceae: Commeelina clavata Clarke Aneilema paniculatum wall A. vaginatum R. Br			August August
Palmeae: Phoenix sylvestris L Caryota urens L		ij	January-February Flowers during most of the year.
Araceae : Amorphophallus commutatus E Ariopsis peltata Nimmo. Remusalia viripara Schott.	Engler 		May-June June—September
Cyperaceae: Cyperus deformis Linn. C. iria var. paniciformis	••		October—January September
Gramineae: Oplismenus compositus Beaun Ischaemum diplopogon Hook. Arthraxon inermis Hook. Tripogon capillatus Jaub. T. jacquemontii Stapl			November-December October September
Name of the species			Flowering period (1897)
Ranunculaceae: Delphinium dasycaulon Fresen deae.		ari-	August-September
Capparis horrida Linn. f. Bixad Flacourtia montana Grah.	ceae	••	November—April November-December
Guttiferae: Garcinia ovalifolia Hook, f.	••	••	
Dipterocarpaceae: Ancistrocladus hyneanus Wall.	•		March

Name of the species	S		Flowering period (1897)
Malvaceae: Urena sinuata Linn. DC. Hibiscus hirtus Linn Kydia calycina, Roxb.	• •	••	October-November OctoberJanuary November
Sterculiaceae : Eriolaena stocksii, H.f.T.			
Tiliaceae: Erinocarpus nimmoanus Grah	l .		August-September
Lineaceae: Reinwardtia trigyna Hook.		• •	January
Rutaceae: Murraya exotica Linn.			June—October
Burseraceae: Garuga pinnata Roxb Canarium strictum Roxb.		••	February-March February-April
Meliaceae: Cedrela toona Roxb	***		January
Celastrineae: Celastrus paniculata Willd, Hippocratea grahami Wight			November—February January—April
Rhamnaceae: Ventilago maderaspatana Go Zizyphus xylopyrus Wild. Scutia indica Brongn	etn.	ĮÝ.	December—January May—July February—April
Ampelideaceae: Leea sambucina Willd		77	July—October
Sapindaceae: Allophylus cobbe, Blume Schleichera trijuga, wild Sapindus trifoliatus, Linn.	यमेव यमेव	ग्यते नयते	May—August February—May
Leguminosae: Desmodium cephalotes wall, Erythrina stricta Roxb. Dalbergia paniculata Roxb.		••	August—October February—May April-May
Rosaceae: Cotoneaster frigrda wall.			
Crassulaceae: Bryophyllum calycinum salisl	b.		January
Combretaceae: Anogeissus latifolia wall.			May—July
Cucurbitaceae: Hukia leiosperma Thwaites			
Rubiaceae: Anotis rheedii W. and A. Mussaenda frondosa Linn, Pavetta indica Linn.		•••	July October March—May
Compositae: Elephantopus scaber Linn. Pulicaria wightiana Clarke	••		September—November

Name of the Species		Flowering period (1897)
Sapotaceae: Sideroxylon tomentosum Roxb.	••	October—January
Bassia latifolia Roxb	••	January—April January—March
Oleaceae: Ligustrum neilgherrense Wight		August-November
Loganiaceae: Strychnos colubrina Linn		October—January
S. potatorum Linn. f Gentianaceae:	• •	April-May
Exacum petiolare Griseb Canscora diffusa Br	••	October—January
Boraginaceae: Cordia myxa Linn.		March-April
Ehretia laevis Roxb, Trichodesma zeylanicum Br	• •	January—June January
Convolvulaceae: Porana malbarica Clarke		October
Scrophulariaceae: Vandellia crustacea Benth	1	August
Ilysanthes hyssopioides Benth.		August October-November
Ramphicarpa longiflora Benth.	1000	October-November
Centranthera hispida Br	7.5	September-October
Bignoniaceae: Heterophragma Roxburghii DC. H. ademophyllum Seem.		February—April
Acantheaceae:	N 55	PS,
Hygrophila serpillum T. Anders		September—January
H. Spinosa T. Anders	••	September—January
Doedalacanthus purpurasoens	লাবন	November—January
Strobilanthes asper Wight S. perboliatus T. Anders	• •	October
Calacanthus dalzelliana T. Anders	• •	December—March October—December
Barleria prionitis Linn	•••	October—January
B. gibsoni Dalz.	• •	September—November
B. grandiflora Dalz	••	November
Justicia betonica Linn		October—December
Myristicaceae: Myristica attenuata wall		October-February
Lauraceae:		
Beilachmiedia bagifolia Nees	• •	
Dehaasia cuneata Blumer	• •	* • • • •
Alseodaphne semicarpifolia Nees.	••	July—December
Euphorbiaceae: Macaranga roxburghii Wight		
Salicineae: Salix tetrasperma Roxb	••	October
Burmania coelestris Don		
Orchidaceae: Habenaria plantaginea Lindl	••	

Name of the species

Flowering period (1897)

H. stenostachya Benth.

H. wightii Trimen

Commelinaceae:

Aneilema pauciflorum Wight .

Cyperaceae:

Cyperus difformis Linn. .. October—January

C. iria, Linn. December

C. tuberosus Rott.

Gramineae:

Pogonatherum saccharoideum Beauv.

Beauv.

Tripogon capillatus Jaub and Spoch. September

Filicineae:

Polypodiaceae:

Polybotrya appendiculata, Willd. Gymnoptesis contaminans Wall.

G. subreeta Hook.

10.3. Flora of Raigad Hill Fort

Another significant promontory of Sahyadris, which had attracted the attention of botanists, is Raigad Fort. This is a strong hill-fort with significant vegetation different from that of other hill-forts like Sinhgad, Purandar and Torna. In this connection the account of flora of Purandar Fort given elsewhere be compared with that of Raigad.

It is situated between 18°.14' latitude North and 73°30' East, 25.7 kilometres to the north of Mahad town. It was the capital of Shivaji from 1664 to 1680 A. D. It has scarped sides which isolate it from the surrounding country, and a flat top of about four kilometres. It is 2851' above the M. S. L. It is 2.4 km. east-west and 1.6 km. north-south. Its south and east sides are extremely scrapped continuously, steep as those of Jibraltar rock.

The weather is sultry, coming up through Konzar valley 12.8 km. Raigad gives a panoramic view of the surrounding country and other hill forts like Pratapgad, Raigad and Torana. There are 10-12 lava flows separated by the bands of red and green earth or red-bole. The topmost layers are hard and compact. Many dykes and transverse joints pass through them allowing water to percolate, and to form lakes.

Vegetation on the top is of mixed deciduous type, and semi-evergreen type forest in the valleys. It is not much disturbed due to isolated position of the fort. The ravines below are full of it, consisting of Terminalia paniculata, Terminalia crenulata, Bridelia squamosa, Lagerstroemia lanceolata, Gmelina arborea, Bombax cieba, Dillenia pentagyna, Fagara budrumga and Syzygium cumini. The trees here form 40' high canopy. They are mixed with small shrubs of Randia brandisii, Ixora arborea, Allopyllus serratus, Bauhinia racemosa, climbers like Celastrus paniculata, Tinospora cordifolia, Zizyphus rugosa, Calycopteris floribunda, etc. Thespesia lampas occurs here and there. The herebaceous flora is rather meagre consisting of Desmodium triquetrum, Blepharis asperrima, Eranthemum roseum and Colebrookia oppositifolia. A few orchids grow on trees such as Aerides crispum and Dendrobium barbatulum, Eria dalzelli, Oberonia sps. and also Hoya wightii. Of these

Terminalia crenulata, Dillenia indica Thespesia lampas and Orchids suggest moist deciduous type of vegetation, whereas Bridelia squamosa, Gmelina arborea. Dalbergia sympathetica, Jasminum malabaricum, Memycelon umbellatum, Colebrookia oppositifolia suggest dry and semi-evergreen type of vegetation. At the foot of the hill the vegetation becomes sparse and is typical of dry hills. Here one notices Grewia tilaefolia, Reinwardtia trigyna, and Lasiosiphon eriocephalus. They suggest mixed vegetation. Sterculia guttata, Bombax insigne on the hill opposite Chita-Darwaja suggest dry vegetation, as in drier areas of Lonavala and Khandala in seasons other than rainy season.

A little higher from the base of the hill one gets Carvia callosa, Glochidion hohenackeri, Erinocarpus sp, Mappia foetida, Mallotus philipinesis, Barleria prionitis, Ficus hispida, Callicarpa lanata, Strobilanthus sps, Abutilon polyandrum. They are also common in the upper part of the hill as they are elsewhere in Sahyadri ranges. Within the enclosure of the hill fort Vitex negundo, Mallotus philippinesis, Pimpinella sps. occur in dry habitats. They are usually associated with Lobelia nicotinifolia, Terniola zeylanica, grown on moist soil.

At present attempts are being made to plant a number of trees of Casuarina equisetifolia, Peltophorum feruginosum, Delonix regia, Semicarpus indica, Dalbergia latifolia. They all grow pretty well. A detailed list of plants on Raigad is given below from which it becomes clear that the flora is neither entirely dry or moist deciduous nor semi-evergreen, but a mixture of the two. Apparently the vegetation must have been altered much later, but must be richer in the past as humidity throughout the year is quite high. The species in the villages here and on the Sahyadri plateaus are a mixture of species common on the Konkan plain and on the slopes and semi-dry coastal forests of Malabar, but their density is not as great as that in Goa, north Kanara or Malabar.

List of the Plants of "aigad Fort (after Vartak, 1966)

(Names given in brackets are Marathi)

Ranunculaceae Clematis gouriana Roxb. (Morvel).

Delleniaceae
Dillenia pentagyna Roxb. (Karmal)

Annonaceae
Sageraea laurina D. and G. (Sayeri)

Menispermaceas
Tinospora cordifolia Miers, (Gulvel)
Cocculus hirsutus Diels. (Vasanvel)
Stephania japonica Miers.
Cyclea burmanni Miers (Pahadvel)
Diplocilisia glancescens Diels. (Vatoli)

Capparidaceae Capparis spinosa L. (Kabar) Capparis pedunculosa Wall. (Kolishna)

Flacourtiaceae
Flacourtia latifolia Cooke (Tambat)

Portulacaceae

Portulaca oleracea L. (Gholu)

Malvaceae

Sida veronicifolia Lam.
Sida rhombifolia L. var. retusa Masters (Chikana)
Abutilon polyandrum W. and A.
Urena lobata L.
Hibisus hirtus L.
Hibisus tetraphyllus Roxb. (Ranbhendi)
Hibisus rosa-sinensis L. (Jaswand)
Thespesia populnea Soland.
Thespesia lampas Dalz.

Bombacaceae

Bombax cieba L.
Bombax insignis wall.

Sterculiaceae

Sterculia guttata Roxb. (Goldar) Helicteris isora L. (Murudsheng)

Tiliaceae

Grewia tiliaefolia Vahl. Grewia abutiltfolia Vent. Erinocarpus nimmonii Graham Triumfetta rhomboidea Jacq. Corchorus capsularis L.

Linaceae

Reinwardtia trigyna Planch.

Oxalidaceas

Oxalis corniculata L.

Balsaminaceae

Impatiens balsamina L.

Rutaceae

Fagara budrunga Roxb. Murraya koenigii Spreng. Atlantia racemosa W. and A.

Meliaceae

Melia composita Willd. Heynea trijuga Roxb.

Hippocrateaceae

Pristimera grahami A. C. Smith

Celastraceas

Celastrus paniculata Willd Gymnosporia rothiana Laws

Rhammaceae

Zizyphus jujuba Lamk. Zizyphus rugosa Lamk. Zizyphus oenoplia Mill.

Ampelidaceae

Cissus elongata Roxb Cissus latifolia Vahl Cissus repanda Vahl. Lega indica Merrill

Sapindaceae

Allophyllus serratus Radlk.

Anacardiaceae

Mangifera indica L.
Anacardium occidentale L.
Lannea coromandelica Merrill
Semicarpus anacardium L.

Papilionaceae

Crotalaria fillipes Benth. Crotalaria prosstrata Roxb. Crotalaria bifaria L. Crotalaria retusa L. Indigofera linifolia Retz Indigofera pulchella Roxb. Geissaspis cristata W. and A Smithia purpurea Hook. Smithia conferta Sm. Alysicarpus vaginalis DC. Alysicarpus sp. Desmodium triflorum DC. Desmodium triguetrum Teramnus lubialis Spreng Mucuna prurita Hook. Erythrina variegata L. Butea monosperma D. Kuntze Atylosia lineata W. and A. सत्यमव जयत Cyfista scariosa Roxb. Moghania strobilifera St. Hil. Dulbergia latifolia Roxb Dalbergia sympathetica Nimmo Pongamia pinnata Pierre

Caesalpiniaceae

Delonix regia Raf.
Wagatea spicata Dalz.
Cassia fistula L.
Cassia tora L.
Peltophonum inerme Naves.
Bauhinia racemosa Lamk.
Tamarindus indica L.

Mimosaceae

Acacia chundra Willd.
Acacia concinna DC.
Acacia intsia Willd.
Albizzia odoratissima Benth.
Albizzia procera Benth.

Crassulaceae

Bryophllum pinnatum Oken

Combretaceae

Terminalia arjuna W. and A. Terminalia crenulata Roth Terminalia paniculata Roth. Calycopteris floribunda Lamk. Anogeissus latifolia Wall Combretum ovalifolium Roxb.

Myrtaceae

Syzygium cumini Skoels Syzygium jambos Alston

Melastomaceae

Osbeckia truncata Don Memecylon umbellatum Burm.

Lythraceae

Rotala tenuis Kashna Rotala indica Koshna Woodfordia fruticosa Kurr Lawsonia inermis L. Lagerstroemia parviflora Roxb. Lagerstroemia lanceolata Wall.

Samydaceae

Casearia graveolens Dalz.

Cucurbitaceae

Trichosanthes bracteata Voigt Trichosanthes cucumerina L. Cucumis melo var. agrests Nand Melothria heterophylla Cogn. Cucurbita maxima Duch.

Umbellifarae

Trachispermum stictocarpum Wolff Pimpinella adscandens Dalz. Centella asiatica Brphn.

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Rubiaceae

Mitragyna parvifolia Korth.
Oldenlandia coymbosa L.
Anotis lancifolia Hook.
Randia brandisil Gamble
Canthium dicoccum Merril
Meyna laxiflora Robyn
Ixora arborea Roxb.
Ixora nigricans R. Br.
Pavetta indica L.
Hamiltonia suaveolens Roxb.

Compositae

Centratherum phyllolaenum Benth Vernonia cinerea L. Ageratum conyzoides L. Cyathocline purpurea Kunth Conyza stricta Willd. Blumea oxydonta DC.

Blumea malcolmii Hook.
Blumea membranacea DC.
Sphaeranthus indicus L.
Gnaphalium indicum L.
Vicoa cernua Dalz.
Caesulia axillaris Roxb.
Eclipta alba L.
Erigeron asteroides Roxb.
Tridax procumbens L.
Altemisia parviflora Buch-Ham
Senecio grahmami Hook
Tricholepis glaberrima DC.
Acanthosperumum hispidum DC.

Lobelia ceae Lobelia nicotianifolia Heyne Lobelia alsinoides Lamk.

Plumbaginaceae
Plumbago zeylanica L.

Myrsinaceae Embelia tsjeriam-cottam A. DC.

Sapotaceae
Pouteria tomentosa Baeclni

Oleaceae Jasminum malabariculm L. Jasminum grandiflorum L.

Apocynaceae
Carissa congesta Wight
Holarrhena antidysenterica Wall
Wrightia tinctoria R. Br.
Plumeria acuminata Ait.
Tabernaemontana divariegata R. Br.

Asclepiadaceae

Hemidesmus indicus R. Br. Cryptolepis buchanani Room. Calotropis gigantea R. Br. Tylophora Sp. Hoya wighti Hook.

Gentianaceae

Centeurium roxburghii Druce: Canscora diffusa R. Br.

Boraginaceae

Cordia dichotoma Forst Cordia macleodii Hook. Cynoglossum glochidiatum Wall. Adelocaryum coelestinum Brand.

Convolvulaceae

Porana malabarica C. B. C. Ipomoea nil Roth

Solanacae

Solanum indicum L. Solanum nigrum L. Physalis minima L. Nicotiana tabacum L.

Scrophulariaceae

Verbascum coromandelianum Kuntz. Striga gesneroides Vatke. Lindenbergia urticifolia Link.

Bignoniaceae

Oroxylum indicum Vent. Heterophragma quadriloculare K. Schem.

Acanthaceae

Blepharis asperrima Nees Hygrophila serpyllum T. Anders Hemigraphis latebrosa Nees Eranthemum roseum R. Br. Pleocaulus ritchiei Bremek. Carvia callosa Bremck. Thelepaepale ixiocephale Bremek. Strobilanthus sp. Haolanthus vagrticillatus Nees. Barleria prionitis L. Barleria cuspidata Heyne Barleria lawii T. Anders Neuracanthus sphaerostechyus Dalz. Asystasia gangetica T. Anders Rungia pectinata Nees Dicliptera zeylanica Nees Justicia simplex D. Don Justicia betonica L. Adhatoda vasica Nees Rhinacanthus hirsuta kurtr

Verbenaceae

Lantana camara L.
Callicarpa tomentosa Murray
Tectona qrandis L.
Gmelina arborea Roxb.
Vitex negundo L.

Labiatae

Ocimum sactum L.
Pogostemon plactranthoides Desf.
Dysophylla stellata Benth.
Colebrookea oppositifolia Smith
Anisomeles heyneana Benth.
Leucas stelligera wall.
Leucas montana Spreng.
Leucas ciliata Benth.

Amaranthaceae

Aerva sanguinolenta Blume Achyranthus aspera L. Alternanthera sessilis R. Br. Amaranthus hybridus L.

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Podostemaceae Terniola zeylanica Tul.

Polygonaceae Polygonum plebejum R. Br. Polygonum glabrum Willd.

Loranthaceae

Dendrophthoe falcata Etting. E. Taxillus cuneatus Danser

Euphorbiaceae

Euphorbia hirta L.
Euphorbia elegans Spreng
Bridelia squamosa Gehrum
Glochidion hohenackeri Bedd.
Melanthesa turbinata Wight
Cicca acida Merrill
Mallotus philippinesis Lamk.
Tragia mulleriana Pay

Ulncaceae

Holoptelea integrifolia Planch

Urticaceae

Girardiana zeylanica Deiane Boehmeria scabrella Gand

Moraceae

Ficus bengalensis L.
Ficus rumphii Blume
Ficus religiosa L.
Ficus arnottiana Mig.
Ficus hispida L.
Ficus glomerata Roxb.
Artocarpus integra Merrill

Casuarinaceae Casuarina equisetifolia L.

Orchidaceae

Oberonia recurva Lindl, Dendrobium barbatulum Lindl Dendrobium sp. Eria dalzellii Lindl. Aerides sp. (eriopum?)

Dioscoreaceae

Dioscorea pentaphylla L. Dioscorea bulbifera L. Dioscorea oppositifolia L.

Agavaceae:

Agave cantala Roxb.

Liliaceae

Asparagus racemosus Willd.

Smilaceae

Smilax zevlanica L.

Cyperaceae
Cyperus iria L.
Cyperus malabaricus Clarke
Cyperus natans Vahl,
Cyperus pumilus L.
Fimbristylis dichotoma Vahl.

11. FLORA OF RATNAGIRI AND SINDHUDURG DISTRICTS:

Ratnagiri being a very large district, it was customary to speak of it as made up of two parts, North and South Ratnagiri. They are now actually formed into two districts: Southern part is called Sindhuderg and Northern part as Ratnagiri district. The flora of South Ratnagiri (Sindhudurg) including Sawantwadi is very rich and contains many plants that are common to North Kanara, Malabar, and a few to the hilly regions of high altitude on Desh side. The flora of North Konkan or Ratnagiri on the other hand, contains several species which are common to Bombay, Thane, South Gujarat, the Dangs and Panch Mahal. It is not so rich in plants like Sindhudurg district, as the rainfall becomes less as one goes northwards. The flora of South Ratnagiri is better known due to efforts of early botanists like Dalzell, Gibson, Talbot, Dalgado and especially Nairne. All these botanists had first-hand knowledge of South Konkan plants as they actually lived there and collected plants. Nairne (1894) was living in Vengurla as an officer in the Ecclesiastic Service of the Bombay Government. As such there are numerous references to local plants of South Konkan in his "Flowering Plants of Western India". Cooke (1903-1908) included in his work many species of both North and South Konkan not on his collections, but solely the collections of others. made by the early botanists. His account, therefore, lacks specific mention of localities and he often describes distribution as "common in Konkan Hills", "Konkan Jungles", "North and South Konkan" etc. This is unhelpful to the collectors who want to collect and study distribution of a particular species. In his Flora of the Bombay Presidency there are references to Konkan flora comprising 1038 dicotyledonous plants and 337 monocots. But when one examines the plants he has mentioned from a few localities such as Ratnagiri, Mirya Dongar, Mandangad, Chiplun, Pen, Dapoli, Dasgaon, Snrivardhan, Varasgaon, Alibag, and Kalyan, one is disappointed to note that the plants he mentioned with localities in North Konkan are from well known places and are mostly herbaceous such as Crotolaria albida, Indigofera tinctoria, Smithia setulosa, Blumea oxydonta, Ipomoea lawii Pedalium murex, Dadelacanthus rosea, Lepidagathis cristata, Rungia parviflora, Euphorbia microphylla, Zingiber macrostachys, Panicum myosuroides, Aurundinella avenacea, and a few shrubs like Casearia Clerodendron serratum. Trees and creepers one finds graviolens, still less. Anthoceplalus indicus, Cassia grande, C.absus, Ixora nigricans etc. On the other hand references to herbs, trees and shrubs from South Konkan are many. That only shows how poor were the collections made in North Ratnagiri.

Nairne's (1894) flora on the other hand mentions several other plants like Unona discolor, Ventilago latifolia, Uraria fistula, Carallia integerima, Calycoteris floribunda, Oimanthus urecelatus. There is no doubt about them because Nairne had collected intensively during his long stay at Vengurla. Many plants of South Ratnagiri or Sindhudurg represent moist types and some evergreen species e.g. Litsea, Mesua Dipterocarpus which are not to be found in North Konkan. Represen-

tative flora of Ratnagiri district would be similar to those found in the Bombay Island, Salsette, Thane hills and valleys around Bombay.

Recently the flora of Sindhudurg district has been fully worked out by Dr. B.G.Kulkarni of the Botanical Survey of India, Pune, and the list of plants given here is mainly on the basis of his work. Although now North and South Ratnagiri are politically two districts, botanically they are the parts of the same sub-province and therefore their plants are dealt with together here.

Flora of South Konkan, abounds in places with moist or humid species forming semi-evergreen vegetation and a few pockets of evergreen vegetation in the depressions and ghats. Both the districts have continuous ranges of Sahyadris with straight drop at places on the west; for example in Amboli ghat at a village called Tambechi Wadi, at a village Palgaon there is a straight drop of rock 1000' to 1500' forming a huge escarpment. This gives heavy rainfall in the areas adjacent to Sahyadris, but not so in the areas near coast. The parts of Konkan, therefore, at the foot of the Sahyadris are marshy. Where the soil is accumulated there is good forest. Where there is no soil, it is very poor in Varkas soil. At the west margin of Konkan, Sahyadri ranges end abruptly, from crest to sea coast. There is plain. The principal species of the two districts are given together. The flora of Kankavali is known better and is given separately.

The whole Konkan is traversed by a number of small rivers from Alibag, Chiplun to Sawantwadi and Terekhol. They form rich mangrove vegetation on their bank in a number of places, and in semi-marine conditions at other places.

At the coast also there are mangroves in mud flats and a belt of strand plants behind them in sandy or clayey areas. A number of sand binders grow in the sands behind the mud flat. A large number of medicinal plants are known from Sindhudurg district. The two districts are quite suitable for cultivation of plantation crops, palms and fruit trees especially at Dapoli, Deogad, Ratnagiri and Sawantwadi. However soil being poor only minor millets are grown as crops in Konkan.

The flora of Goa and Sindhudurg district was studied by Dalgado (1896) with reference to Sawantwadi. It contains some pockets of evergreen vegetation. A number of medicinal plants and some newly introduced plants such as cashew and good mango varieties are grown. Cocoa (Theobroma cocoa) grows well in Sawantwadi. It has a great potential for plant introduction of Rubber, Spices, Jute etc. started earlier by Dalgado (1896). He was serving as Civil Surgeon of Sawantwadi State. The Ratnagiri and Raigad districts have hot water springs. Their flora is unworked. Mangroves and strand plants flora and vegetation of Kankavali are better known. The ghat flora of Amboli, Amba, and Phonda deserve special attention for research.

Sawantwadi and its plants and flora

It is very rich in flora being, contiguous with Goa, North Kanara, Kolhapur and Malabar. Its plant are mentioned here mainly with the help of the work of Dr. B. G. Kulkerni (1979) who has made a special study of South Ratnagiri. The important plants in its flora are intended in the common list.

11.1. Plants of Ratnagiri and Sindhudurg

Name	Fl. Season		Locality
Ranunculaceae Clematis gouriana Roxb	OctNov.		Phonda ghat,
C hedysarifolia DC	OctNov.		Amboli ghat Kankavali,
Naravelia zeylanica DC	Oct.—Dec.	••	Kudal S. M. country only in the ghats
Dilleniaceae			
Dillenia indica Linn	June	••	Alibag, Sawant- wadi, South Konkan
D. pentagyna Roxb	MarApr.	••	Sawantwadi, on Western face of ghats, Matheran
Magnoliaceae			
Michelia champaca Linn,	Apr.—Sept.	• •	Cultivated
Anonaceae			
Meiogyne pannosa (Dalz) Sincl.	MARK		Amboli, Kan- kavali
Sageraea laurifolia (Grdhi) Blatt.			Kankavali, Ramghat
Uvaria narum (Dunal) Blume	Nov		Kankavali,
सर	रमेव जयते		Amboli, Phonda
Anona squamosa Linn	May—July	••	Cultivated
Menispermaceae			
Tinospora cordifolia (Willd) Miers	Apr	••	Deogad, Konkan common
T. sinensis (Lour) Merr	••		Vengurla
Anamirta cocculus (Linn.) Wand A.	• •		Kankavli, Phonda, Konkan
Cocculus hirsutus (Linn) Diels			common Phonda, Kan-
•	• •		kavali, Kudal
Diploclisia glauceascens (Bl.) Diels	••		Kankavali, Amboli, Kudal
Stephania japonica (Thumb.) Miers	••		Amboli
Cissampelos pareira, Linn, .,	••		Malwan, Deogad, Kankavali
Nymphaeaceae			
Nymphaea pubescens Willd N. nouchali Burm f A-127—31-B			Kudal Malvan

Name		Fl. Season		Locality
Papaveraceae Argemone mexicana Linn.	••	All the year	• •	Kankavali, Kudal, (In- troduced as weed)
Brassica ceae Brassica juncea (Linn) Cze	rn.			Bhedshi, culti-
- '		• •		vated
Cardamine trichocarpa Hoc ex Rich.	hst	••		High hills of Konkan, Amboli
Raphanus aestivus Linn.	••	••		Malvan, cultivated
Capparidaceae				
Cleome viscosa Linn.	••	Sept.—June	••	Guest House at Vengurla, Kudal, Bhedshi
C. chelidonii Linn. f.	••	July—Feb.	••	Ramghat, moist places
". speciosa Ref "rataeva nurvala Buch-Har ataeva nurvala Buch-Har var. C. religiosa Mart. apparis rotundifolia Rott!.	n			Kankavali Malvan Bhedshi, Sawant- wadi. Amboli, Deogad,
C. zeylanica Linn.	1	Feb.—Apr.	• •	Malvan. Deogad, Malvan, Akeri, Vengurla
C. moonii wt	E	Jan	••	Amboli ghat, Bhedshi
Violaceae	CO.			2
Hybanthus, enneaspermus (L) Muell. Hybanthus, suffruticosus (Linn) Baill ex Lan.	स	यमेव जयते		
Bixaceae				
Bixa orellana Linn	••	AugSept.	••	Kudal, Introduced
Flacourtiaceae				
Hydnocarpus laurifolia (Dennst) Sleum.		••		Kankavali, Kudal, Amboli ghat
Homalium, zeylanicum Bent Flacourtia, montana Grah.	:n.	NovDec.	••	Amboli ghat Kankavali, Kudal, Bhedshi
F. indica (Burm. f.) Merr.	••	••		Deogad, Kudal hills of Konkan Malvan
Casearia graveolens Dalz.		••		Kankavali, Malvan, Kudal, Vengurla
C. esculenta Roxb	• •	• •		Kankavali, Bhedshi
C. rubescens Dalz		••		Kankavali, Kudal

Name	Fl. Scason	Locality
Pittosporaceae Pittosporum nepdulense (DC.) Rehd and Wilson.		Amboli ghat
Polygalaceae Polygala elongata Klein ex Willd.	Aug.—Nov.	Malvan, Sawant- wadi, Deogad, Kankavali, Kudal
Salomonia ciliata (Linn.) DC.	••	Malvan
Caryophyllaceae Polycarpon prostratum (Forsk.) Asch. and Schw.	••	Vengurla, Kudal
Polycarpea corymbosa (Linn.) Lamk.	OctJan.	Malvan, common in vicinity.
Portulaca ceae Portulaca oleracea Linn	Oct.—Dec.	Deogad, Akeri as weed in cultivated.
Tamaricaceae Tamarix ericoides Rottl	Nov.—Jan.	,. Kankavali
Elatinaceae Bergia ammannioides Roxb. ex Roth.	NovDec.	Abyssinian plant on margins of tank
Thou.) Choisy. G. talbotii Raiz. ex Sant.	Nov.—Feb.	Kudal, Sawantwadi, Vengurla. Kankavali, Sawant- wadi.
Mammea suriga (Buch. Ham ex Roxb) Kosterm. Calophyllum inophyllum Linn.	DecJan.	Kankavali, Kudal Deogad, Sawant-
	March	wadi Sawantwadi Kudal, Bhedshi, forests of Sawant- wadi.
Ancistrocladaceae: Ancistrocladus heyneanus Wallex Grah.		Kankavali, Bhedshi, Matheran, Thane, ghats.
Malvaceae: Sida cordata (Burm. f.) Bross.	Oct.—Jan.	Deogad, Sawant- wadi., Malvan.
Sida rhombifolia Linn S. cordifolia Linn	Oct.—Dec. OctNov.	Kankavali, Bhedshi- (weed). Malwan
Abutilon persicum (Burm. f.) Merr.		Kudal, Bhedshi
Abutilon indicum (Linn.) SW	All the year	Deogad, common in S. Matheran.

Name	Fl. Season	Locality
Urena lobata Linn	Oct.—Dec	Kudal, Bhedshi, Kalyan.
Decaschistia trilobata Wt	OctNov.	A t. ii Vankayali
Hibiscus furcatus Roxb	Dec.—Feb	. Kankavali, Sawant- wadi.
H. hirtus Linn. Var. talbotii Rakshit.	Oct.—Jan.	Matheran, Phonda.
H. witifolius Linn	Oct.—Dec	Revdanda, Matheran, Malvan
H. cannabinus Linn		. Ghats, Kankavali . Cultivated
Abelomoschus manihot Ssp. tetraphyllus (Roxb. ex. Horn) Bross.		. Kudal, Bhedshi . Sawantwadi country
Sterculiaceae : Peterospermum acerifolium	Dec.—Mar	. Cultivated
willd. Melochia corchorifolia Linn. Waltheria indica Linn.		Deogad, KudalKonkan, Vasai,Deogad, Malvan.
Tiliaceae:		. Konkan, Kankavali,
Grewia umbellata Roxb		Sawantwadi.
G. tilaeifolia Vahl. Var. leptopetala Cooke	1 1 1 1 1 1 1 1	Elephanta, Salsette Deogad, Bhedshi Kankavali, Bhedshi
G. serrulata DC G. nilosa Lamk	Aug.—Oct.	17 L 11. Dl. adabi
G. pilosa Lamk G. abutilifolia Vent. ex Juss.		Kankavan, Bnedshi Deogad, Sawant- wadi.
Microcos paniculata Linn	क्यांत ज्याने	Sawantwadi, Kan- kavil hills.
Erinocarpus nimmonii Grah. ex Dalz and Gibs.	AugSept.	Kankavali, Sawant- wadi
Triumfetta rhomboidea Jacq. Corchorus capsularis Linn	Sept.—Dec. September	Deogad, Bhedshi Kankavali, Sawant- wadi.
C. aestuans Linn		Deogad, Sawant-
C. olitorius Linn	September	Deogad
Elaeocarpaceae: Elaeocarpus serratus Linn.	. JanFeb.	Bhedshi
Linaceae: Linum mysorense Heyne e Benth. apud, Lindl.	x Oct.—Dec.	Kankavali, Sawant- wadi hills.
Reinwardtia indica Dumort.		Sawantwadi
Malpighiaceae : <i>Hiptage benghalensis</i> (Linn Kurz.	.)	Kankavali, Sawant- wadi, ghat jungles, also cultivated.
Aspidopteris cordata (Heyn Juss.	e) Sept.—Nov.	Kankavali, Sawant- wadi, Salsette island.

Name	Fl. Season		Locality
Oxalidaceae: Oxalis cornicuulata Linn Biophytum candolleanum Wt.	Oct.—May		Sawantwadi Kankavali, Sawant- wadi.
Balsaminaceae: Impatiens acaulis Arn		• • •	Kankavali, Sawant-
I. kleinii W. and A			wadi, Matheran. Mirya dongar, Kan-
I. pusilla Heyne ex Hook. f. and Th.	Aug.—Oct.	• •	kavali, Bhedshi. Sawantwadi
I. lawii Hook f. and Th	October	• •	S. Konkan, Sawant- wadi.
1. balsamina Linn		••	Konkan ghat, Deogad Sawantwadi.
I. pulcherrima Dalz	SepOct.	• •	Fitzgerald ghat
Rutaceae:			
Evodia lunu-ankenda (Gaertn.) Merr.		٠.	Sawantwadi
Zanthoxylum rhetsa (Roxb) DC.	色病	• •	
Zanthoxylum limonella (Dennst.) Alston.			Vengurla, Kankavali, Sawantwadi.
Toddalia asiatica (Linn.) Lamk.		••	Sawantwadi
Acronychia pedunculata (Linn.) Miq.	TIME		Sawantwadi
Glycosmis mauritiana (Lamk.) Tanaka.			Moist evergreen Konkan forest, Sawantwadi.
Murraya paniculata (Linn.) Jack.	प्रमेव जयते	••	Kankavali, Bhedshi, Matheran.
M. koenigii (Linn.) Spreng,	Feb.—Apr.	••	Kudal, Sawantwadi, ghats.
Clausena dentata (Will) Roem.		••	Sawantwadi, Boriv- li forest.
Lavanga sarmentosa (Bl.) Kurz.		• •	Sawantwadi
Paramignya monopnhylla Wt.	Nov.—Jan.	• •	Konkan, Bhedshi, Amboli ghat.
Atalantia racemosa W and A.	NovDec.	• •	S. Konkan, Amboli ghat.
Ochnaceae: Ochnacobtusata DC			Kankavali, Bhedshi
	FebMar.	••	Kankavali, Bhedshi Konkan, hills of Matheran.
Meliaceae: Naregamia alata W. and A.	AugOct.		Malwan, Bhedshi, Panvel, Vengurla.
Turrea villosa Benn	Apr.—June	***	S. Konkan, Kankavali, Sawantwadi.

PLOKA	or monant		
Name Amoora lawii Bedd	Fl. Season DecJan.	••	Locality Kankavali, Bhedshi, hills of Nagothana,
Walsura trifoliata (A. Juss.)			Amboli ghat. Sawantwadi.
Harms. Dysoxylum binectariferum (Roxb.) Hook f. ex Bedd.		• •	Kankavali, Bhedshi, Phonda ghat.
Trichilia connaroides (Wt and Arn) Bent.	_		Kankavali Matheran. Kan-
Chukrassia tabularis Juss. var. velutina King.	Feb.—Apr.	••	Matheran, Kan- kavali, Bhedshi, Tungar hills.
Toona ciliata Roem.	May	••	Matheran hills, Kudal, Bhedshi.
Dichapetalaceae: Dichapetalum gelonioides (Roxb.) Engl.	MarApr.	••	Sawantwadi.
Olacaceae: Olax wightiana wall. ex W. and A.	Dec.—Feb.	••	Kudal, Bhedshi, High hills of Konkan.
Opiliaceae: Cansjera rheedii Gmel	Hall		Elephanta, Malvan, Sawantwadi, Salsette island.
Icacinaceae : Nothopodytes foetida (Wt.) Sleum.	Mar.—May		Kankavali, Sawantwadi.
Celastraceae: Lophopetalum wightianum Arn.	Mar.—May	••	Kankavali, ever- green forest of Konkan
Euonymus indicus Heyne ex Wall.	• •		Sawantwadi.
Meytenus rothiana (Walp.) Ramm, Cassine glauca (Rottb)	••		Konkan, Bhedshi, Sawantwadi.
O. Ktze.			
Celastrus paniculata (Wt. and Arn.) Lob.	Nov.—Feb.	••	Konkan, Bhedshi, low jungles in hilly parts.
Hippocratea, grahamii Wt	Jan.—Apr.	••	Bhedshi, Matheran, moist ghat forests of Thane.
H. indica Willd	Apr.	••	Kudal, Bhedshi, moist forest along the ghats.
Salacia chinensis Linn. S. macrosperma Wt	Jan.		Kankavali, Konkan, Amboli ghat
Rhamnaceae: Scutia circumscissa (Linn. f.) Druce.	••		Kudal, Bhedshi, Phonda.
Ventilago, maderaspatana Gaertn.	Dec-Jan.	••	Kankavali, Matheran.

V. bombaiensis Dalz. Cohbrina, asiatica (Linn.) Brongn. Zizyphus, xylopyrus Willd. Z. oenoplia (Linn.) Mill. AugSept. Zrugosa Lamk. Vitaceae: Ampelocissus latifolius (Roxb.) Planch. Cissus discolor Bl. C. repens Lamk. C. repanda Vahl. C. advata Roxb. PebMar. C. advata Roxb. Domin. C. elongata (Roxb.) Suess Lecaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. Aug. Aug. Aug. Aug. Aug. Aug. Aug. Aug	Name	Fl. Season		Locality
Zizyphus, xylopyrus Willd. Z. oenoplia (Linn.) Mill. Z. rugosa Lamk. Dec.—Feb. AugSept. Annelocissus latifolius (Roxb.) Planch. Cissus discolor Bl. C. repens Lamk. C. repens Lamk. C. veganda Vahl. C. adnata Roxb. Nov.—Feb. Kankavali, Sawantwadi. Sawantwadi. Sawantwadi. Deogad, Bhedshi. C. relongata (Roxb.) Suess July—Sept. Ghat jungles, Matheran, Malvan. Moist forest Kudal, Sawantwadi. Deogad, S	Colubrina, asiatica (Linn.)			Deogad, Elephanta,
Z. oenoplia (Linn.) Mill. Z. rugosa Lamk. Dec.—Feb. Chats Conkan, Deogad, Sawantwadi. Vitaceae: Ampelocissus latifolius (Roxb.) Planch. Cissus discolor Bl. C. repens Lamk. C. repanda Vahl. C. adnata Roxb. Nov.—Feb. Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess Lecaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. L. cispa Linn. L. edgeworthii Sant. L. indica (Burm, f.) Merr. L. robusta Roxb. Aug. Sawantwadi. Sawantwadi. Sawantwadi. Linn. Aug. Mirya Dongar, Pen, Sawantwadi. Sawantwadi. Dec, Malvan. May—Aug. Mirya Dongar, Pen, Sawantwadi. Sawantwadi. Dec, Malvan. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Feb-Mar. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. Jan.—Mar. Kudal, Sawantwadi. Kankavali, Bhedshi. Kudal, Sawantwadi.	Zizyphus, xylopyrus Willd.	MayJuly	••	Deogad, Bhedshi, ravines of Mathe-
Ampelocissus latifolius (Roxb.) June—Aug. Planch. Cissus discolor Bl. AugSept. Kankavali, Bhedshi. C. repens Lamk. FebMar. Kudal, Bhedshi. C. repanda Vahl. Apr.—June Kudal, Sawantwadi. C. adnata Roxb. Nov.—Feb. Kankavali, Kudal. Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) May-June Kudal, Sawantwadi. Capratia trifolia (Linn.) May-June Lecaceae: Leea macrophylla Roxb. Suess July-Aug. Deogad, Bhedshi. Lecaceae: Leea macrophylla Roxb. ex Hornem Aug. Moist forest Kudal, Sawantwadi. L. crispa Linn. Aug. Moist forest Kudal, Sawantwadi. L. crispa Linn. Aug. Moist forest Kudal, Sawantwadi. L. robusta Roxb. July-Aug. Deogad, Sawantwadi. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz May-June Buchanania lanzan Spreng. Jan.—Mar. Kudal, Sawantwadi. Bhedshi, Sawantwadi. Kankavali, Sawantwadi. Kankavali, Sawantwadi. Kankavali, Sawantwadi. Kankavali, Sawantwadi. Sawant		AugSept. DecFeb.		Ghats Konkan, Deogad,
Ampelocissus latifolius (Roxb.) June—Aug. Planch. Cissus discolor Bl. AugSept. Kankavali, Bhedshi. C. repens Lamk. FebMar. Kudal, Bhedshi. C. repanda Vahl. Apr.—June Kudal, Sawantwadi. C. adnata Roxb. Nov.—Feb. Kankavali, Kudal. Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) May-June Kudal, Sawantwadi. Capratia trifolia (Linn.) May-June Lecaceae: Leea macrophylla Roxb. Suess July-Aug. Deogad, Bhedshi. Lecaceae: Leea macrophylla Roxb. ex Hornem Aug. Moist forest Kudal, Sawantwadi. L. crispa Linn. Aug. Moist forest Kudal, Sawantwadi. L. crispa Linn. Aug. Moist forest Kudal, Sawantwadi. L. robusta Roxb. July-Aug. Deogad, Sawantwadi. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz May-June Buchanania lanzan Spreng. Jan.—Mar. Kudal, Sawantwadi. Bhedshi, Sawantwadi. Kankavali, Sawantwadi. Kankavali, Sawantwadi. Kankavali, Sawantwadi. Kankavali, Sawantwadi. Sawant	Vitaceae:			
C. repens Lamk. C. repanda Vahl. Apr.—June C. adnata Roxb. Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess Leeaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. Aug. July—Sept. Leageworthii Sant. L. edgeworthii Sant. L. robusta Roxb. L. robusta Roxb. Aug. July—Aug. L. robusta Roxb. Aug. May-June Chat jungles, Matheran, Malvan. Moist forest Kudal, Sawantwadi. Deogad, Sawantwadi. Deogad, Sawantwadi. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. Jan.—Mar. Kudal, Sawantwadi. Kudal, Sawantwadi Kudal, Sawantwadi May-Aug. Mirya Dongar, Pen, Sawantwadi. Mirya Dongar Vengurla, Bhedshi, Kankavali, Sawantwadi, Kankavali, Bhedshi, Kankavali, Bhedshi, In evergreen forest. Kudal, Bhedshi, Kudal, Sawantwadi	Ampelocissus latifolius (Roxb.) Planch.		• •	_
C. repanda Vahl. C. adnata Roxb. Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess Leeaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. Aug. July—Sept. Hornem L. cdgeworthii Sant. L. edgeworthii Sant. L. robusta Roxb. L. robusta Roxb. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. Kudal, Sawantwadi. Sawantwadi. Chat jungles, Matheran. Matheran. Moist forest Kudal, Sawantwadi. Deogad, Sawantwadi. Deogad, Sawantwadi. Deogad, Sawantwadi. Deogad, Matheran. Matheran. Moist forest Kudal, Sawantwadi. Deogad, Matheran. Matheran. Mirya Dongar, Pen, Sawantwadi. Mirya Dongar Vengurla, Bhedshi, Saleste island. Sawantwadi, Matheran. Kankavali, Bhedshi, Saleste island. Sawantwadi. Kankavali, Bhedshi, Saleste island. Sawantwadi. Kudal, Sawantwadi. Kankavali, Bhedshi, Saleste island. Sawantwadi. S			• •	
C. adnata Roxb. Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess Leeaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. L. edgeworthii Sant. L. edgeworthii Sant. L. robusta Roxb. L. robusta Roxb. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. May-June Kudal, Sawantwadi Kudal, Sawantwadi Kudal, Sawantwadi Kathavali, Sawantwadi Kankavali, Bhedshi, Salsette island. Sawantwadi Kankavali, Bhedshi, Salsette island. Kankavali, Bhedshi, Salsette island. Kankavali, Bhedshi, Kankavali, Bhedshi, Salsette island.				
Tetrastigma canarense (Dalz.) Gamble. Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess Leeaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. Aug. July—Sept. July—Sept. Ghat jungles, Matheran, Malvan. Moist forest Kudal, Sawantwadi. L. edgeworthii Sant. July—Aug. Deogad, Bhedshi. L. edgeworthii Sant. July—Aug. L. indica (Burm, f.) Merr. Feb.—Oct. Kankavali, Bhedshi. L. robusta Roxb. Aug. Malvan. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Feb-Mar. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. Jan.—Mar. Kudal, Sawantwadi. Kudal, Sawantwadi. Sawantwadi. Kudal, Sawantwadi. Sapindaceae: Sawantwadi. Sawantwadi. Sawantwadi. Sawantwadi. Sawantwadi. Sawantwadi. Sawantwadi. Sawantwadi. Sawantwadi. Sawantw		Apr.—June		
(Dalz.) Gamble. Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess July-Aug. Deogad, Bhedshi. Leaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. Aug. July-Sept. Horiem Aug. L. edgeworthii Sant. L. edgeworthii Sant. July-Aug. July-Aug. Deogad, Sawantwadi. L. edgeworthii Sant. July-Aug. Deogad, Sawantwadi. L. indica (Burm, f.) Merr. Feb.—Oct. Kankavali, Bhedshi. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Feb-Mar. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. Jan.—Mar. Kudal, Sawantwadi Kudal, Sawantwadi Kudal, Sawantwadi Kankavali, Bhedshi, Salsette island. Kankavali, Bhedshi, Salsette island. Sawantwadi Kudal, Sawantwadi Bhedshi, in evergreen forest.				
Cayratia trifolia (Linn.) Domin. C. elongata (Roxb.) Suess July-Aug. Leeaceae: Leea macrophylla Roxb. ex Hornem L. crispa Linn. L. crispa Linn. L. edgeworthii Sant. L. edgeworthii Sant. July-Aug. L. indica (Burm, f.) Merr. L. robusta Roxb. July-Aug. July-Aug. L. robusta Roxb. Aug. Moist forest Kudal, Sawantwadi. L. edgeworthii Sant. July-Aug. L. indica (Burm, f.) Merr. Feb.—Oct. Kankavali, Bhedshi. Bhedshi. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Feb-Mar. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz May-Junc May-Junc Kudal, Sawantwadi Kudal, Sawantwadi. Sawantwadi Kudal, Sawantwadi. Bhedshi, in evergreen forest. Buchanania lanzan Spreng. Jan.—Mar. Kudal, Bhedshi, Bhedshi, in evergreen forest. Kudal, Bhedshi,		reo,-wai.	• •	Sawantwatti.
C. elongata (Roxb.) Suess July-Aug Deogad, Bhedshi. Leeaceae: Leea macrophylla Roxb. ex Hornem	Cayratia trifolia (Linn.)	May-June	• •	Kudal, Sawantwadi
Leea macrophylla Roxb. ex Hornem Leea macrophylla Roxb. ex Hornem L. crispa Linn. L. crispa Linn. L. edgeworthii Sant. L. edgeworthii Sant. L. indica (Burm, f.) Merr. L. robusta Roxb. L. robusta Roxb. L. robusta Roxb. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Muy.—Sept. July.—Sept. July.—Sept. July.—Sept. July.—Sept. July.—Sept. Moist forest Kudal, Sawantwadi. Decgad, Sawantwadi. Marya Dongar, Pen, Sawantwadi. Mirya Dongar Vengurla, Bhedshi. Kankavali, Sawantwadi, Salsette island. Sawantwadi, Salsette island. Sawantwadi. Kankavali, Bhedshi, Salsette island. Sawantwadi.		July-Aug.		Deogad, Bhedshi,
Leea macrophylla Roxb. ex Hornem L. crispa Linn. Aug. Moist forest Kudal, Sawantwadi. L. edgeworthii Sant. July-Aug. L. indica (Burm, f.) Merr. L. robusta Roxb. July-Aug. L. robusta Roxb. Aug. Moist forest Kudal, Sawantwadi. Deogad, Sawantwadi Kankavali, Bhedshi. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Mug. Moist Moest Kankavali Marya Dongar Vengurla, Bhedshi Kankavali, Sawantwadi Kankavali, Sawantwadi Kankavali, Bhedshi, Salsette island. Sawantwadi	Cramation (Etc.)			2 ,
Hornem L. crispa Linn. Aug. Matheran, Malvan. Moist forest Kudal, Sawantwadi. L. edgeworthii Sant. July-Aug. Deogad, Sawantwadi L. indica (Burm, f.) Merr. L. robusta Roxb. Aug. Moist forest Kudal, Sawantwadi. Le edgeworthii Sant. July-Aug. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Feb-Mar. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Mug. Mirya Dongar Vengurla, Bhedshi. Kankavali, Sawantwadi, Kankavali, Matheran. Kankavali, Bhedshi, Salsette island. Sawantwadi. Kankavali, Bhedshi, Salsette island. Kankavali, Bhedshi, Salsette island. Sawantwadi. Kankavali, Bhedshi, Salsette island. Sawantwadi. Kankavali, Bhedshi, Salsette island. Sawantwadi. Kankavali, Bhedshi,				
L. crispa Linn Aug Moist forest Kudal, Sawantwadi. L. edgeworthii Sant July-Aug Deogad, Sawantwadi L. indica (Burm, f.) Merr Feb.—Oct Kankavali, Bhedshi. L. robusta Roxb Aug Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Malvan. Linn. Allyophylus cobbe (Linn.)		July—Sept.	••	Matheran,
Kudal, Sawantwadi. L. edgeworthii Sant. July-Aug. Deogad, Sawantwadi L. indica (Burm, f.) Merr. Feb.—Oct. Kankavali, Bhedshi. L. robusta Roxb. Aug. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) May—Aug. Mirya Dongar Vengurla, Bhedshi. Schleichera oleosa (Lour.) MarApr. Kankavali, Sawantwadi, Matheran. Dimocarpus longan Lour. Feb-Mar. Kankavali, Bhedshi, Salsette island. Sapindus laurifolius Vehl Cot.—Dec. Sawantwadi. Lepisanthes tetraphylla Feb.—Apr. Kankavali, Bhedshi, Salsette island. (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz May-June Bhedshi, in evergreen forest. Buchanania lanzan Spreng. Jan.—Mar. Kudal, Bhedshi,	I crisna Linn	Aug.		
L. indica (Burm, f.) Merr Feb.—Oct	L. Crispa Ellin.		••	Kudal,
Bhedshi. L. robusta Roxb. Aug. Bhedshi. Mirya Dongar, Pen, Sawantwadi. Sapindaceae: Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. May—Aug. Malvan. Mirya Dongar Vengurla, Bhedshi. Mirya Dongar Vengurla, Bhedshi. Kankavali, Sawant- wadi, Matheran. Kankavali, Bhedshi, Salsette island. Sawantwadi. Feb.—Apr. Kudal, Sawant- wadi. Bhedshi, in ever- green forest. Kudal, Bhedshi,	L. edgeworthii Sant.	July-Aug.	• •	
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Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. May—Aug. May—Aug. Mirya Dongar Vengurla, Bhedshi. Kankavali, Sawant- wadi, Matheran. Kankavali, Bhedshi, Salsette island. Sawantwadi. Feb.—Apr. Kudal, Sawant- wadi. Bhedshi, in ever- green forest. Kudal, Bhedshi, in ever-	L. robusta Roxb	Aug.	••	
Cardiospermum helicacabum Linn. Allyophylus cobbe (Linn.) Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. May—Aug. May—Aug. Mirya Dongar Vengurla, Bhedshi. Kankavali, Sawant- wadi, Matheran. Kankavali, Bhedshi, Salsette island. Sawantwadi. Feb.—Apr. Kudal, Sawant- wadi. Bhedshi, in ever- green forest. Kudal, Bhedshi, in ever-	Sapindaceae :			
Raeusch. Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. MarApr. Mankavali, Bhedshi, Kankavali, Bhedshi, Kankavali, Bhedshi, MarApr. MarApr. Mankavali, Bhedshi, MarApr. Mankavali, Bhedshi, MarApr. Mar	Cardiospermum helicacabum	Dec.	••	Malvan.
Schleichera oleosa (Lour.) Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and A.) Hook-f. H. grahamii (Wt.) Kurz Buchanania lanzan Spreng. MarApr. Kankavali, Sawant- wadi. Kankavali, Bhedshi. Kankavali, Bhedshi. Kudal, Sawant- wadi. Bhedshi, in ever- green forest. Kudal, Bhedshi,	Allyophylus cobbe (Linn.) Raeusch.	May—Aug.	••	Vengurla,
Oken. Dimocarpus longan Lour. Sapindus laurifolius Vehl Oct.—Dec Sawantwadi. Lepisanthes tetraphylla Feb.—Apr Kankavali, Bhedshi. (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and JanFeb Kudal, Sawantwadi. A.) Hook-f. H. grahamii (Wt.) Kurz May-June Bhedshi, in evergreen forest. Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,	Schlaichara aleasa (Lour)	Mar -Apr		
Dimocarpus longan Lour. Sapindus laurifolius Vehl Oct.—Dec Sawantwadi. Lepisanthes tetraphylla Feb.—Apr Kankavali, Bhedshi. (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and JanFeb Kudal, Sawantwadi. A.) Hook-f. H. grahamii (Wt.) Kurz May-June Bhedshi, in evergreen forest. Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,		Mat/spi.	••	
Sapindus laurifolius Vehl Oct.—Dec Sawantwadi. Lepisanthes tetraphylla Feb.—Apr Kankavali, Bhedshi. (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and JanFeb Kudal, Sawantwadi. A.) Hook-f Kudal, Sawantwadi. H. grahamii (Wt.) Kurz May-June Bhedshi, in evergreen forest. Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,		Feb-Mar.	• •	Kankavali, Bhedshi,
Lepisanthes tetraphylla (Vahl) Radik. Anacardiaceae: Holigarna arnottiana (W. and JanFeb Kudal, Sawant-wadi. A.) Hook-f. H. grahamii (Wt.) Kurz May-June Bhedshi, in ever-green forest. Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,	Sapindus laurifolius Vehl	Oct.—Dec.		
Holigarna arnottiana (W. and JanFeb Kudal, Sawant- A.) Hook-f. wadi. H. grahamii (Wt.) Kurz May-June Bhedshi, in ever- green forest. Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,	Lepisanthes tetraphylla (Vahl) Radik.		••	Kankavali, Bhedshi.
H. grahamii (Wt.) Kurz May-June Bhedshi, in ever- green forest. Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,	Holigarna arnottiana (W. and	JanFeb.		
Buchanania lanzan Spreng. Jan.—Mar Kudal, Bhedshi,	A.) Hook-i. H. grahamii (Wt.) Kurz	May-June	••	Bhedshi, in ever-
Sawani wani.	Buchanania lanzan Spreng.	Jan.—Mar.		

Name	Fl. Season	Locality
Mangifera indica Linn Nothopegia dalzellii Gamble Semecarpus anacardium Linn. f,		Mostly cultivated.Konkan, Bhedshi.Malvan, Bhedshi.
Spondias pinnata (Linn. f.) Kurz.	Feb	Malvan.
Lannea coromandelica (Houtt) Merr.	FebMar	Ç,
Anacurdium occidentale Linn.	Jan.—Mar	. Kankavali, Sawant- wadi, Vengurla.
Connaraceae: Rourea praineana Talb	Sept.—Nov	Sawantwadi, Mirya dongar
Connarus wightii Hook. f	Feb.	TZ 1 11 4 4 4 4
C. ritchiei Hook. f	Apr	Sawantwadi, Bhedshi.
Fabaceae:		
Erythrina orientalis Linn	Feb.—Apr	Kankavali, Bhedshi, Matheran.
Butea monosperma (Lamk.) Taub.	FebMar.	T7 1
Derris indica (Lamk.) Ben. Pongamia pinnata (Linn.) Pierre.	Feb.—Apr	Kankavali, Kudal.
Dalbergia latifolia Roxb	AYYAY	Kankavali, Bhedshi, Vengurla.
D. paniculata Roxb	AprMay	X4.41 T. 1 .
D. sympathetica Nimmo ex Grah.		Kudal, Bhedshi, Matheran.
	FebMar	131 111 2
Pterocarpus marsupium Roxb.	May-June	T7 1 11
Mucuna monosperma DC.		Kudal, Bhedshi.
M. prurita Hook. Canavalia virosa (Roxb.) Wt. and Arn.	Aug.—Dec	~
C. rosea (SW.) DC.		Malwan, Venguria.
Cylista scariosa Roxb	Nov.—Feb	Kudal, Bhedshi, Matheran.
Abrus precatorius Linn	Sept.—Oct	TT 1 11
Derris trifoliata Lour. D. scandens (Roxb.) Benth. D. canarensis (Dalz) Bak. D. heyneana Benth.	June—Aug	Deogad, Malwan. Kudal, Bhedshi.
Goniogyna hirta (Willd.) Ali.		Kankavali,
Crotolaria filipes Benth C. albida Heyne ex Roth.:	Oct—Dec Dec—Feb	Sawantwadi. Salsette island. Kankavali, Kudal.
C. linifolia Linn, f	Sept	Konkan, Malwan, Bhedshi
C. lutescens Dalz	Aug—Oct	Vengurla, Malwan.

Name	Fl. Season	Locality
C. nana Burm. f. C. prostrata Rottl. ex Willd.	SeptOct OctNov	Vengurla, Malwan. Kankavali, Sawantwadi.
C. vestita Baker C. retusa Linn. C. mysorensis Roth	Sept.—Nov	Deogad, Bhedshi. Konkan plains.
C. verrucosa Linn	OctNov	Kankavali, Ven- gurla, Bhedshi.
C. triquetra Dalz	Oct	Malvan, Vengurla, Sawantwadi.
C. mucronata Desv. Alysicarpus vaginalis (Linn.) DC.	Oct	South Konkan. Sawantwadi, Deogad, Konkan.
A. procumbens (Roxb.) Schindl.	••	Malwan,
A. bupleurifolius (Linn.) DC.	June—Sept	Kankavali, Sawant- wadi, Vengurla.
A. longifolius Wt. and Arn. A. rugosus (Willd.) DC.	Sept	Malwan. Malwan.
A. belgaumensis wt	SeptOct	Kankavali, Bhedshi. Kudal, Malabar hill, Bhedshi.
D. gangeticum (Linn.) DC.	May—July	77 1 7 7 7 1
D. pulchellum (Linn.) Benth. D. heterocarpon (Linn.) DC.	AugOct	Sawantwadi Kankavali, Sawant- wadi, Matheran hills
Desmodium laxiflorum DC.	Aug.—Oct	Kankavali, Bhedshi, Phonda ghat.
D. triangulare (Retz.) Merr. D. triflorum (Linn.) DC.	Oct. July	Deogad, Bhedshi. Konkan, Sawant- wadi.
Uraria rufescens (DC.) Schindl,	• •	Kankavali, Bhedshi, Salsette island.
Zornia diphylla (Linn.) Pers.	Aug,-Sept	Kankavali, Sawant- wadi.
Pycnospora lutescens (Roir.) Schindl.	• •	Kankavali.
Pseudarthria viscida (Linn.) Wt. and Arn.	AugSept	Kankavali, Sawant- wadi, Vengurla.
Vigna vexillata (Linn.) A, Rich.	• •	Kankavali, Bhedshi.
V. pilosa (Willd) Bak. V. dalzelliana (Kuntze)	••	Bhedshi. Sawantwadi,
Verd, V. radiata (Linn.) Wil.	••	Bhedshi. Kankavali, Sawant- wadi.
var. sublobata (Roxb.) verde. V. mungo (Linn.) Hepper Teramnus labialis (Linn. f.)	••	Sawantwadi. Kankavali, Bhedshi. Sawantwadi.
Spreng. Atylosia lineata Wt. and Arn. A. searabaeoides (Linn.) Benth.	Oct.—Dec	Konkan hills. Deogad, Bhedshi.

Name	Fl. Season	Locality
Aeschynomene indica Linn.	• •	Kankavali, Bhedshi, Matheran.
Geissaspis cristata Wt. and Arn.	••	Kankavali, Sawant- wadi.
G. tenella Benth. Smithia conferta Sm.	* · · · · · · · · · · · · · · · · · · ·	Kankavali, Bhedshi Kankavali, Sawant- wadi, Malwan.
S. sensitiva Ait S. agharkarii Hem. S. hirsuta Dalz.		Kudal, Sawantwadi. Sawantwadi. Phonda.
S. bigemina Dalz.	-	Kankavali, Sawant- wadi.
S. salsuginea Hance . Indigofera nummularifolia (Linn.) Liv. ex, Alston.		Konkan. Malwan.
I. linifolia (Linn, f.) Retz. I. cordifolia Heyne, ex Roth	July—Oct. Aug.—Dec. July—Sept.	Uran, Kankavali. Uran, Malwan. Malwan, Sawant-
I. tinctoria Linn	. NovDec.	wadi, Bhedshi Kankavali, Sawant-
1. astragalina DC.		wadi. Deogad, Sawant- wadi.
I. hirsuta L	. Aug.—Oct. . Oct.	Neral Kankavali, Bhedshi. Malwan, Bhedshi.
S. procumbens (Roxb.) Wt.	TATIN	Bhedshi.
S. aculeata Poir Moghania strobilifera (Linn.)	., SeptOct	. Wet places in Konkan Kankavali, Bhedshi
St. Hil. ex O. Ktze. M. macrophylla (Willd.) O. Ktze.	सन्यमेव जयते	Kudal, Bhedshi.
Caesalpiniaceae:		
Bauhinia racemosa Lamk	. Mar.—June	Hilly part of Konkan, Deogad, Kankavali.
B. malabarica Dalz. Caesalpinia bonducella (Linn		Moist forest Deogad, Malwan.
Roxb. C. crista Linn. C. spikata Dalz. C. mimosoides Lamk	 Oct.—Jan.	Deogad, Malwan. Deogad, Bhedshi.
g	Oct.—Jan.	Sawantwadi, Mahim Bhedshi, common in
C. fistula Linn,	Mar.—May	ghat toward Goa Konkan ghat, Kan-
C. mimosoides Linn	. Oct.—Dec.	kavali, Bhedshi Deogad, Sawant-
C. occidentalis Linn.	Jan.—Mar.	wadi. Kankavali, Malwan.

Name	Fl. Season		Locality
C. absus Linn	Sept.		Bandod, Dapoli, Vengurla, Deogad,
C. tora Linn C. kleinii Wt. and Arn	NovDec.	• •	Kudal, Bhedshi Konkan, Jambhul
Saraca asoea (Roxb.) dewilde	Dec.—May		South Konkan ghats
Tamarindus indica Linn. Mimosaceae	May-June	••	Kankavali
Mimosa pudica Linn	SeptOct.	••	Cultivated at Mal- wan, Bhedshi.
Willd.	Aug.—Mar.	••	Deogad, cultivated and naturalised.
A. chundra (Roxb.) Willd A. rugata (Lamk.) Hem. ex Merr.		• •	Kankavali, Bhedshi Deogad, Bhedshi
A. torta (Roxb.) Craib A. pinnata (Linn.) Willd	June—Aug.	··	Kankavali, Bhedshi Mumbra near Thane
Neptunia oleracea Lour	Aug.—Oct.		Common in tanks in
Albizzia lebbek (Linn.) Benth.	_	••	Bombay.
	Engl -		Kankavali, Bhedshi common.
A. odoratissima (Linn. f.) Benth.	Apr.—June	• •	Kudal, Bhedshi
A. chinensis (Osb.) Merr A. amara Bolvin	Apr.—June	• •	Kankavali, Bhedshi Matheran hills
Entada pursaetha DC Xylia xylocarpa (Roxb.) Taub.		• •	Kudal, Bhedshi
X. dolabriformis Benth	MarApr.	٠.	S. Konkan, Sawant- wadi.
Leucaena leucocephala (Lamk.) Dewit.		••	Sawantwadi—culti- vated.
Rosaceae: Prunus zeylanica (Wt.) Miq. Vahliaceae	त्यमेव जयते		Kankavali, Bhedshi
Vahlia digyna (Retz.) O. Ktze. V. viscosa Roxb		••	Kankavali Bombay
Crassulaceae: Kalanchoe pinnata (Lamk.) Pers.			Kankavali, Bhedshi
Droseraceae: Drosera burmanni Vahl	DecFeb.	• •	Kudal, Sawantwadi
D. indica Linn	OctNov.	••	wadi, Salsette,
Rhizophoraceae:			Vengurla.
Carallia brachiata (Lour) Merr.	Dec.—Mar.	••	Kankavali, Bhedshi
Rhizophora mucronata Lamk.	Aug.—Dec.	••	Deogad, Vengurla, along sea coast.
R. conjugata Linn	Aug.—Dec.		Vengurla, along
Ceriops tagal (Perr.) Robins.			sea coast. Deogad

Name	Fl. Season		Locality
Kandelia candel (Linn.) Druce.		••	Malwan
Bruguiera gymnorhiza (Linn.) Lamk.	Dec.—Feb.	••	Deogad, along sea coast.
B. cylindrica (Linn.) Blume		••	Vengurla along sea coast.
Combretaceae: Combretum ovalifolium Roxb.	Jan.—Mar.		Jungles in Konkan and in ghats, Elephanta.
C. latifolium Blume	Mar.—May	• •	Kankavali, Bhedshi Deogad, Bhedshi
Terminalia paniculata Roth	AugSept.	••	Kankavali, Sawant- wadi at the foot of ghat.
T. arjuna (Roxb. ex DC.) Bedd.	AprMay	• •	Matheran, Deogad, Kudal.
T. bellerica (Gaertn.) Roxb.	Feb.—May	• •	Kankavali, Bhedshi, at the foot of ghat.
T. crenulata Roth Anogeissus latifolia Wall			Kankavali, Bhedshi Along the rivers and in wells in dry forest also.
T. chebula Retz	AprMay	••	Along the line of ghat near Kudal,
Luminitzera racemosa Willd.	Jan.—April		Bhedshi. South Konkan along salt water Creeks, Deogad.
Myrtaceae:			
Syzygium phillraeoides(Trim.) Sant.	यमेव जयते		Kankavali, Sawant- wadi.
Alston.	MarApr.	••	Konkan, Kankavali, Bhedshi.
S. montanum (Wt.) Gamble S. caryophyllatum (Linn.) Alston.			Kudal Deogad, Bhedshi
S. zeylanicum (Linn.) DC S. cumini (Linn.) Skeels S. heyncanum Wall. ex Wt. and Arn.	Mar.—May	••	Kudal, Bhedshi Kankavali, Bhedshi Kankavali, Bhedshi
Psidium quajava Linn.		• •	
Barringtoniaceae: Careya arborea Roxb	MarApr.	••	Common in South Konkan, Kan- kavali, Bhedshi.
Barringtoniaacutangula (Linn.) Gaertn.	SepOct.	• •	Deogad, Bhedshi
B. racemosa (Linn.) Spreng.	AprMay		Malwan
Melastomaceae: Sonerila scapigera Hook Osbeckia truncata Ge.	July-Aug. Oct. —Dec.	•••	Sawantwadi Kankavali, Sawant- wadi.

Name	Fl. Season		Locality
Melastoma malabathricum Linn.	Oct.—Mar.	••	Vengurla, Kudal, Bhedshi.
Memecylon umbellatum Burm M. talbotianum Brand	Jan.—Маг. MarАрг.	•••	Kankavali, Bhedshi, Kudal, Bhedshi
Lythraceae: Rotala occultiflora Koehne. R. densiflora (Roem. and sch.) Koehne. R. indica (Willd.) Koehne. R. Irotundifolia (Roxb.) Koehne.			Kankavli Deogad, Sawant- wadi. Malwan Kankavali, Bhedshi
Ammannia multiflora Roxb A. baccifera Linn Nesaca lanceolata (Heyne ex Wall.) Koehne.	November November	•••	Kudal, Sawantwadi
Woodfordia fruticosa (Linn.) Kurz.		• •	Deogad, Bhedshi
Lagerstroemia flos-reginae Roxb.	Apr.—June	٠.	Sawantwadi
L. parviflora Roxb	June	٠.	Konkan, Sawant- wadi, Matheran
L. microcarpa Wt L. lanceolata Wall Lawsonia inermis Linn	MarApr. MarApr. Apr.—July		~
Sonneratiaceae: Sonneratia apetala Buch Ham. S. caseolaris(Linn.) Engl	February	••	Salt marshes Bom- bay, Malwan. Deogad, Vengurla
Onagraceae: Ludwigia octovalvis (Jacq.) Raven ssp.	त्यमेव जयते		In fresh watertanks at Kankavali, Bhedshi.
Sessiliflora (Mich) Rav L. perennis Linn.		•••	Malwan, Sawant-
L. hyssopifolia (G. Don) Exell.		٠.	wadi. Malwan, Bhedshi
Passifloraceae: Passiflora foetida Linn. Adenia hondala (Gaertn.) De Wilde.		••	Deogad Sawantwadi
Cucurbitaceae: Tricosanthes bracteata (Lamk.) Voigt.			Kankavali, Bhedshi
T. cucumerina Linn.	JulyOct.		
Luffa acutangula (Linn.) Roxb.	June—Sept.		wadi. Kankavali, Bhedshi
var <i>amara</i> (Roxb.) C. B. Cl. L. cylindrica (Linn.) Roem. Momordica charantia Linn.	May Aug.		Sawantwadi Deogad, Sawant- wadi,
M. dioica Roxb. ex. Willd	June-Aug.	••	Kankavali, Sawant- wadi.

Name	Fl. Season		Locality
Coccinia grandis (Linn.) Voigt. Zahnaria scabra (Linn. f.) Sond.		••	Malwan,Sawantwadi Kankavali
Mukia maderaspatana (Linn) Roem.			Malwan, Sawant- wadi.
Solena heterophylla Lour Kedrostis rostrata (Rottl.) Cogn.	SeptNov.	 	Kankavali, Bhedshi
Dicaelospermum ritchiei C. B. Cl.	July—Sept.	••	Kankavali
Begonia ceenata Dryand	AugSept.	• •	Deogad, Sawant- wadi.
Tetramelaceae: Tetrameles nudiflora R.Br.	FebMar.		Kankavali, Sawant- wadi.
Aizoaceae : Mollugo pentaphylla Linn	Sept.—Nov.		Kankava!i, Sawant- wadi.
Glinus lotoides Linn. G. oppositifolius (Linn.) A. DC.		••	Sawantwadi Deogad, Bhedshi
Apiaceae : Centella usiatia (Linn.) Urb. Hydrocotyle sibthorpioides	Mill		Sawantwadi Sawantwadi
Lamk. Pimpinella heyneana (DC.) Kurz.	Aug.—Oct.		Kankavali, Bhedshi
	November		Kankavali, Sawant- wadi.
P. adscendens Dalz Heracleum concanense Dalz.	JanFeb. July-Aug.	•••	Vengurala
Araliaceae: Schefflera venulora (Wt. and Arn.) Harms.		••	Kankavali, Bhedshi
Rubiaceae:			
(Lamk.) Rich. ex. Walp.			Kankavali, Sawant- wadi.
Adina cordifolia (Roxb.) Hook. f. ex Brand.	_		
Mitragyna parvifolia (Roxb.) Korth. Morinda tomentosa Heyne	MayAug.		Kankavali, Sawant- wadi. Deogad
ex Roth. Heymenodictyon aboratum			Sawantwadi
Wall. Wendlandia thyrsoidea (R.			Kankavali, Bhedshi
and S.) Steud. ussaenda fabrata (Hook. f.)			Kudal, Bhedshi
Huch. Ixora nigricans R. Br. ex Wt. and Arn.	All the year		Kankavali, Bhedshi

Name	Fl. Season	Locality
I. coccinia Linn. I. brachiata Roxb. Pavetta crassicaulis Bremek. P. tomentosa Roxb. ex Sm. P. siphonantha Dalz.	All the year Nov.—Feb.	Deogad, Bhedshi Kankavali, Bhedshi Malwan Kankavali, Bhedshi
Psychotria truncata Wall. Chassalia ophioxyloides(Wall.) Graib.	AprMay	Sawantwadi Sawantwadi
Xeromphis spinosa (Thunb.) Keayn.		Kudal, Sawantwadi
X. uliginosa (Retz.) Mahesh- wari.		Kankavali, Bhedshi
Gardenia turgida Roxb Canthium dicoccum (Gaertn). Teysm. and Binn.	Apr.—June	Kankavali Kudal, Bhedshi
C. angustifolium Roxb		Kankavali, Sawant- wadi.
Meyna laxiflora Robyns Randia rugulosa (Thw.) Hook. f.	Jan.—Mar.	Kankavali, Bhedshi Sawantwadi
Borreria pusilla (Wall.) DC. B. ocymoides (Burm. f.) DC.		Deogad, Sawantwadi Malwan
B. articularis (Linn.) F. N. will.		Kankavali, Sawant- wadi.
Neanotis lancifolia (Hook. f.) Lewis. N. rheedii (Wall. ex Wt. and		Kankavali, Sawant- wadi.
Arn.) Lewis. N. montholoni (Hook. f.)	TIME	Sawantwadi Sawantwadi
Lewis. N. foetida (Hook. f.) Lewis	(3)(2)	Sawantwadi Kankavali, Sawant-
Hedyotis auricularia Linn	mina ami	wadi Kankavali, Bhedshi
H. trinervia (Retz.) R. and S. H. maheshwarii (Sant. and Merch.) Rao and Hem.	ৰশণ গণণ	Malwan Sawantwadi
H. herbacea Linn H. corymbosa (Linn.) Lamk.		Kankavali, Bhedshi Kankavali, Sawant- wadi.
Ophiorrhiza prostrata D. Don.		Sawantwadi
Dentella repens (Linn.) J. R. and G. Forst.		Deogad, Bhedshi
	Oct.—Jan.	Sawantwadi
Asteraceae: Crepts acaulis Hook.f. Launea fallax (Jaub-et Spach.) O. Kunt.		Sawantwadi Deogad, Malwan.
	Sept.—Nov.	Kankavali, Sawant- wadi.
S. africanus Linn	Nov.—Jan, October	Kudal, Sawantwadi Deogad
Gynura cusimbua (D. Don) Moore. Emilia sonchifolia (Linn.) DC. ex Wt.		Konkan, Bhedshi Deogad, Bhedshi

Name	Fl. Season		Locality
Adenostemma lavenia (Linn.)			Kankavali, Bhedshi
O. Kuntze. A. geratum conyzoides			Kankavali, Bhedshi
Linn. Dichrocephala integrifolia			Sawantwadi
(Linn.) O. K. Cyathocline purpurea (Don) O. K.		٠.	Kankavali. Bhedshi
	SeptOct. Nov.—Feb. Dec.—Mar. Dec.—Feb.		Sawantwadi. Kankavali, Sawant- wadi. Kudal, Bhedshi Kudal
B. oxyodenta DC B. virens DC	Jan.—Mar. DecJan.	• •	Kudal, Bhedshi Kudal, Bhedshi
B. membranacea DC. B. solidaginoides (Poir.) DC.	May	••	Sawantwadi Kankavali, Bhedshi
B. lacera (Burm. f.) DC Conyza stricta Willd	OctNov.	••	Kankavali, Bhedshi Bhedshi
C. leucantha (D. Don) Ludl. and Rav.	eman	• •	Sawantwadi
Helichrysum indicum (1) Griers.			
Centratherum phyllolaenum (DC.) Benth and C. B. Cl.	SeptOct.	y	Kankavali, Sawant- wadi.
Tricholepis glaberrima DC.	December	٠.	Sawantwadi, Deog-
	JanFeb.		Kankavali
Less. V. divergens (Roxb.) Edgew.	DecFeb.	٠.	Kankavali, Ven- gurla.
Epaltes divaricata cass	MINISTER STATES	٠.	Sawantwadi
Br. and Asch. Synedrella nodiflora (Linn.) Gaertn.	स्यमेव जयते		Malwan, Sawant- wadi.
Tridax procumbens Linn	All the year		Deogad, Sawant- wadi.
Blainvillea acmella (Linn.)			Vengurla
Philips on. Melanthera biflora (Linn.)			Deogad
H. Wilde. Eclipta prostrata (Linn.)		••	Deogad, Sawant- wadi.
Senecio edgeworthii Hook. f. S. grahamii Hook. f.	Aug.—Nov. Aug.—Dec.	••	Kankavali, Sawant-
S. belgaumensis (Wt.) C. B.	Aug.—Jan.		wadi. Deogad, Bhedshi
Cl. Pulicaria angustifolia DC Guizotia abyssinica (Linn. f.) Tithonia diversifolia (Hemsl.) Gray.	NovDec.	••	Kankavali
Sphenocleaceae; Sphenoclea zeylanica Gaertn, A-127—32-A.	Oct.—Dec.	••	Deogad, Malwan

Name	Fl. Season		Locality
Lobeliaceae: Lobelia alsinoides Lamk L. nicotianaefolia Heyne	Nov.—Mar.		Kankavali, Bhedshi Kankavali, Sawant- wadi.
Plumbaginaceae: Plumbago zeylanica Linn	AugSept.	••	Deogad
Primulaceae: Anagallis pumila Sw		••	Sawantwadi
Myrsinaceae: Embelia ribes Burm. f. E. bassal (R. and S.) A. DC. E. tsjeriam-cottam (R. and S.) A. DC. Aegiceros corniculatum (Linn.)	February	•••	Sawantwadi Sawantwadi Kankavali, Sawant- wadi. Deogad, Malwan
Blanc. Maesa indica (Roxb.) Wall Ardisia olanacea (Poir.) Roxb.	Nov.—Jan. Apr.—June	••	Kankavali, Bhedshi Kudal, Bhedshi
Sapotaceae: Xantolis tomentosa (Roxb.) Raf.		••	Kankavali, Bhedshi
Mimusops elengi Linn	Jan.—Mar.	••	Kankavali, Sawant- wadi.
Ebenaceae: Diospyros nigrescens (Dalz.) Sald. D. malabarica (Desr.) Kostel			Kudal, Bhedshi Sawantwadi
The state of the s	Jan.—Mar. Jan.—Apr.	•••	Kankavali, Bhedshi
Symplocaceae: Symplocos laurina Wall. ex Rehl and Wills.			Kudal, Bhedshi
	NovJan.	••	Sawantwadi, Bhed- shi.
Oleaceae : Jasminum rottlerianum Wall ex. DC.	•		Kudal, Bhedshi
		٠	Kudal
Ligustrum perrottetii A. DC. Olea dioica Roxb	. Jan.—Apr.	••	Kankavali, Bhedshi
Apocynaceae : Carissa congesta Wt. C. inermis Vahl	JanFeb.	• • •	Bhedshi Kudal, Bhedshi

Name	Fl. Season		Locality
Chonemorpha fragrans(Moon) Alston.		•• .	Kudal, Bhedshi
Parsonsia helicandra Hook. f. Arn.			Kudal, Bhedshi
Aganosoma cymosa (Roxb.) G. Don.	Apr.—June	••	Kudal, Bhedshi
Anod ndron paniculatum A. DC.	Dec.—Mar.	٠.	Kankavali, Bhedshi
Ichnocarpus frutescens (L.) R. Br.	NovDec.	••	Sawantwadi, Bhe-dshi.
Cerbera manghas Linn Holarrhena antidysenterica (L.) Wall, ex G. Don.	Feb.—June	••	Malwan Deogad, Bhedshi
Wrightia tinctoria R. Br Ervatamia heyneana (Wall.) Cooke.			Kudal, Bhedshi Kankavali, Bhedshi
Alstonia scholaris (L.) R. Br. Rauwolfia serpentina (L.) Bth. ex Kurz.	Dec.—Mar. Mar.—May	••	Kankavali, Bhedshi Kankavali, Bhedshi
R. densiflora (Wall.) Bth. ex Hook, f.	MarApr.	••	Kudal, Sawantwadi
Thevetia peruviana (Perss) K. Sch.		••	Sawantwadi
C. oculata Hook			Kudal, Sawantwadi Kudal Kankavali, Bhedshi Kudal, Bhedshi Bhedshi Kankavali, Sawant- wadi. Deogad, Kudal
T. indica (Burm. f·) Merr Gymnema sylvestre (Retz.) Schult			Kudal, Bhedshi Kudal, Bhedshi
Heterostemma dalzelli Hook. f.	_	••	Vengurla
Cynanchum callialata Ham.		••	Sawantwadi, Bhed-shi.
Leptadenia reticulata (Retz.) W. and A.	Apr.—July	••	Malwan
Periplocaceae Hemidesmus indicus Schult. Cryptolepis buchanani R. and S.	••		Kankavali, Bhedshi Deogad, Bhedshi

Name	Fi. Sea	son	Locality
Loganiaceae Cynotonum mitreola (Britt.	L.) .	Sa	wantwadi
Buddleia asiatica Lour. Strychnos colubrina Linn.	Jan.—Ap Oct.—Jar MarApr	ı Bhe	kavali dshi kavali, Bhedshi
C. diffusa (Vahl) R. Br. C. decurrens Dalz. Exacum lawii C. B. Cl. E. pumilum Griseb. E. bicolor Roxb. E. petiolare Griseb.	Feb. Oct.—Jar Oct.—De AugSep	n.: Kan cc Kan Saw t Kan w ov Kan Kar w	lal, Bhedshi ikavali, Bhedshi ikavali, Kudal antwadi ikavali, Sawant- adi. ikavali, Bhedshi ikavali, Sawant-
Centaurium centaurioides (Roxb.) Rao and Ham.	••	Kan	ikavali, Bhedshi
Hydrophyllaceae Hydrolea zeylanica (Hinn.). Vahl.	. NovDec	c, Kar	nkavali, Bhedshi
Boraginaceae: Ehretia laevis Roxb. E. canarensis Mig. ex C. B. C.	Jan.—J ui Ol	Kar	antwadi 1kavali, Sawant- adi.
Cordia dichotoma Forst. f. Coldenia procumbens Linn. Heliotropium indicum Linn. H. cornutum Johnst.		Kar Kar t Kud ec Kar Dec	nkavali, Bhedshi nkavali, Bhedshi dal, Bhedshi nkavali, Kudal ogad, Sawant- vadi.
H. strigosum Willd. Irichodesma sedgwic kianum Ban.		Kaı	nkavali.
Cynoglossum meeboldii Bra Adelocaryum coelestinum (L		v Ve	nkavali, Sawant- vadi. ngurla, Sawant- vadi.
Convolvulaceae:			
Evolvulus alsinoides (L.) L. Rivea hypocrateriformis (Desv) Choisy.	July—No Aug.—O	ct Sav	gad, Malwan. yantwadi
Stictocardia tiliifolia (Desr.) Hall. f.			kavali, Kudal.
Î avia a ave a D. Da	AugSep	Kar Dec Saw Mal Kar	lal, Bhedshi nkavali, Bhedshi ogad. /natwadi. lwan. nkavali ogad, Malwan

Name	Fl. Season	Locality
I. curassavica All. I. pes-caprae (Linn.) Sw. I. pes-tigridis Linn. I. digitata Linn.	Sept.—Nov July—Sept	
I. diversifolia R. Br		wadi. Malwan, Sawant-
I. fistulosa Mart. ex Choisy Porana racemosa Roxb. Hewittia sublobata (Linn. f.) o. k.		wadi. Kankavali Kankavali Sawantwadi
Merremia tridentata (L.)Hall. f. M. vitifolia (Burm. f.) Hall. f. M. umbellata (L.) Hall. f. var. orientalis (Hall. f.) Van Oost.		Kankavali, Bhedshi
Solanaceae:		
Physalis minima Linn Datura metel Linn	Aug	Deogad, Bhedshi Deogad, Sawant- wadi.
Solanum giganteum Jacq S. indicum Linn. Lycianthes bigeminata (Nees) Bitt.	Jan.—Mar Aug.—Oct, May-June	Bhedshi Kankavali, Bhedshi
Scrophulariaceae:	MITTELL	
Dopatrium Junceum (Roxb.) Buch. Ham. ex Benth.	July—Sept	Sawantwadi
Bacopa floribunda (R. Br.) Wettst.	Oct.	Malwan
Limnophila repens (Benth.) Benth.	Feb	Kudal, Sawantwadi
L. indica (Linn.) Druce L. aquatica (Roxb.) Alston	Nov.—Feb Oct.—Apr	
Torenia indica Sald	Aug.—Oct	Kankavali, Sawant- wadi.
T bicolor Dalz	July	Sawantwadi
<i>Lindernia pusilla</i> (Willd.) Bold.	Feb	Sawantwadi
L. viscosa (Hornem.) Merr. L. rotundifolia (Linn.) Muk. L. crustacea (Linn.) F. Muell. L. anagallis (Burm. f.) Penn.	Aug.—Oct Oct.—Feb Oct.—July May-June	Kankavali, Bhedshi
L. hyssopioides (Linn.) Haines L. parviflora (Roxb.) Haines	Feb Aug.—May	Bhedshi Kankavali, Sawant- wadi.
L. ciliata (Colsm.) Penn	Aug	77 1 1' C 4
L. oppositifolia (Retz.) Muk.	Aug.—June	TT 1 11 71 71 1
Striga gesnerioides (Willd.) Vatke.	Aug.—Apr	T 1 0 .

Name		Fl. Season		Locality
S. asiatica (L.) O. Kuntze	, ••	Aug.—Oct.		Kankavali, Sawant- wadi.
Rhamphicarpa longiflora (Arn.) Bth.		Aug.—Oct.	••	
Sopubia delphinifolia (Roxl G. Don.	0.)	Aug.—Oct.	••	
Centranthera indica (L.) Gamble.		Sept.—Nov.	• •	wadi.
Scoparia dulcis L	• •	• •		Kudal, Bhedshi
Orobanchaceae Aeginetia indica L.	••	• •		Kankavalı, Sawant- wadi.
Lentibulariaceae Utricularia nivea vahl.:				Sawantwadi
U. ulginosa Vahl.	••	••		Kankavali, Sawant- wadi,
U. reticulata Sm.		Oct.	••	Kankavali, Sawant- wadi.
U. striatula Sm	_	Sept.	••	Kankavali, Sawant- wadi.
Gesneriaceae: Rhynchoglossum potianum (Wall.) Burtt.				Kankavali, Sawant- wadi.
R. obliqum Bl. Var. Parv florum C. B. Clarke	i-	Oct.	••	Kankavali, Sawant- wadi.
Epithema carnesum Benth.	Ÿ.	AVIAL		Sawantwadi.
Bignoniaceae: Oroxylum indicum (Linn.) Vent.	院	May—July	••	Sawantwadi
Heterophragma quadrilocula			••	Kankavali, Bhedshi
(Roxb.) K. Sch. Stereospermum personatum (Hassk.) Chatt.	44	यमव जयत		Kankavali, Bhedshi
Pedaliaceae: Pedalium murex Linn.		Oct.		Malwan
Sesamum mulayanum Nair. S. orientale Linn.		• •		Kankavali, Malwan Kankavali, Sawant-
				wadi.
Martyniaceae: Martynia annua Linn.	••	••		Deogad
Thunbergiaceae: Thunbergia laevis Nees		• •		Sawantwadi
Nelsonia canescens (Lam.)		AprMay		Deogad, Vengurla Kudal, Bhedshi
Spr. Staurogyne zeylanica (Nees)	ł.			Kudal, Sawantwadi
o. Kuntze. Hygrophila auriculata (Sch. Heine.				Kudal

Name	Fl. Season		Locality
H. pinnatifida (Dalz.) Sreem Haplanthus verticillatus (Roxb.) Nees.	Dec.		Malwan, Bhedshi Kudal
H. neilgherryensis Wt. Lepidagathis cuspidata (Wall.) Nees.	Mar.		Kudal, Bhedshi Kankavali
L. lutea Dalz L. prostrata Dalz L. fasciculata (Retz.) Nees Barleria prionitis Linn B. cristata Linn	Nov. Dec. Feb. Oct.—Jan. Dec.	•••	Deogad, Malwan Malwan Kudal, Bhedshi Deogad, Bhedshi Kankavali Sawant- wadi.
B. strigosa willd. vartermina- lis (Nees) C. B. Cl. B. prattensis Sant.	Nov.—Dec.	••	Kankavali, Bhedshi Malwan.
Dicliptera zeylanica Nees Blepharis asperrima Nees	Dec.—Mar. Oct.—Dec.	• •	Kudal, Bhedshi Kankavali, Sawant- wadi, Malwan
Andrographis paniculata (Burm. f.) wall. ex Nees. Asystasia dalzelliana Sant	Dec.	••	Kankavali, Sawant-
Gymnostachyum glabrum	Dec.—Feb.	3	wadi. Sawantwadi
(Dalz.) T. And. Rhinacanthus nasutus (L.) Kurz			Sawantwadi
Thelepaepale ixiocephala (Bth.) Brein.	1914843		Kudal, Bhedshi
Rungia pectinata (L.) Nees Mackenzia integrifolia (Dalz.) Brem.	Nov.—Feb.)	Deogad, Bhedshi Kudal, Sawantwadi
Pseuderanthemum malabaricum (C. B. Cl.) Gamble	numia and		Deogad, Malwan
Justicia betonica Linn. J. wynaadensis (Nees) T. Anders.	Oct.—Dec. Nov.—Dec.	••	Kankavali, Bhedshi Bhedshi
J. trinervia Vahl J. procumbens Linn J. simplex D. Don Hen igraphis latebrosa (Heynex Roth) Nees.	Oct.—Jan. Oct.—Mar. Nov.—Dec. Dec.		Sawantwadi Kankavali, Malwan Kudal, Bhedshi Kudal, Bhedshi
Neucanthus sphaerostachyus (Nees) Dalz.	Sept.—Oct.	٠.	Deogad, Malwan
Phaulopsis dorsiflora (Retz.) Sant.			Sawantwadi
Echolium viride var. laetevirens (C. B. Cl.) Sant.	Oct.—Jan.	• •	Deogad, Bhedshi
Eranthemum roseum (Vahl.) R. Br.	•		Kankavali, Bhedshi
Adhatoda vasica (Linn.) Nees Calacanthus grandiflorus	Aug,—Nov.		Sawantwadi Kankavali, Bhedshi
(Dalz.) Radlk. Curvia callosa (Wall.) Brem. Nigirianthus warreensis (Dalz.)		Kankavali, Sawant- wadi. Bhedshi
Brem. N. lupulinus (Wall.) Brem.	•		Sawantwadi

Name	Fl. Season	Locality
N. heyneanus var. neesii Brem. N. reticulatus (Stapf.) Brem.		Sawantwadi, Bhedshi Sawantwadi
Verbenaceae:		
Phyla nodiflora (L.) Greene Avicennia officinalis Linn A. marina var. acutissimas tapf ex Mold. ex Mold.	Apr.—June	Malwan Deogad, Kudal Deogad, Vengurla
Lantana camara L. var. acu- leata (L.) Mold.	All the year	Kankavali, Bhedshi
Vitex altissima Linn. f. V. leucoxylon Linn. f. V. negundo L. V. trifolia L. Callicarpa tomentosa (L.) Murr.	May Feb.—Apr. All the year All the year	
Tectons grandis Linn. f Gmelina arborea Roxb Premna coriacea C. B. cl P. corymbosa (Burm. f.) Rott. C. Willd.	Jun.—Sept. Mar.—May Mat.—May	Sawantwadi Kudal, Bhedshi Sawantwadi Kudal, Sawantwadi
Clerodendrum serratum (L.) Moon.	AugSept.	Kankavali, Sawant- wadi.
C. viscosum Vent.		Deogad, Sawant- wadi.
C. philippinum Schauer	MILIT	
Lamiaceae	RIA WILL	
Leucas ciliata Bth. L. mollissima Wall. ex Benth. L. biflora (Vahl) R. Br. L. lavandulaefolia J. E. Sm. L. aspera (Willd.) Spreng. L. stelligera Wall. ex Benth. Scutelluria discolor Wall. ex Benth.	Oct.—Jan. Aug.—Dec. Oct. Oct. Nov.	 Kankavali, Bhedshi Kankavali, Kudal Kankavali, Bhedshi Kankavali, Bhedshi Malwan Kankavali, Bhedshi Sawantwadi
Orthosiphon thymiflorus (Roth) Slees. Ocimum gratissimum Linn O. americanum Linn. Acrocephalus indicus (Burm.f. o. Kuntze.	JulyOct.	Deogad, Sawant- wadi. Kudal, Sawantwadi Bhedshi Kankavali, Bhedshi
Anisochilus verticillatus Hook. f.	Oct.	Kankavali
Plectranths stocksii Hook, f.	Sept.—Nov	Kankavali, Sawant- wadi.
P. mollis (Ait.) Spreng Colebrookia oppositifolia Sm Dysophylla stellata (Lour.) Bth. Pogostemon benghalense (Burm. f.) O. Kuntze.	Dec.—Apr. Nov.—Jan.	Sawantwadi Kudal, Sawantwadi Kankavali, Sawant- wadi. Kankavali, Bhedshi
P. purpurascens Dalz	Oct.—Jan.	Sawantwadi, Bhed- shi.
Hyptis suaveolens (Linn.) Poit.	••	Deogad, Sawant- wadi.

FLORA OF KONKAN

Name	Fl. Season	Locality
Anisomeles indica (L.) Ktze. A. heyneana Benth.	OctNov	Kankavali, Bhedshi Kankavali, Bhedshi
Nyctaginaceae Boerhaavia diffusa Linn	Nov	Malwan
Amaranthaceae Cyathula prostrata (L.) Bl. Alternanthera sessilis (L.) DC. Aerua sanguinolenta (L.) Bl.	•••	Kankavali, Bhedshi Kankavali, Bhedshi Kankavali, Sawant- wadi. Malwan
Amaranthus tricolor Linn. Celosia argenteà Linn. Achyranthes aspera L. var. porphyristachya Hook, f.	Oct.—Dec	Deogad, Bhedshi Kankavali, Sawant- wadi.
Polygonaceae Polygonum plebejum R. Br. P. chinense Linn. P. strictum Allioni P. glabrum Willd.	Dec.—Mar Nov.—Apr Oct.—Mar	Kudal, Bhedshi Kankavali, Bhedshi, Sawantwadi Kankavali, Sawant- wadi. Kudal, Bhedshi
P. barbatum L. var. gracile Stew.		reduit, phedom
	 Oct.—Dec	Sawantwadi Kudal, Sawantwadi Bhedshi
Piperaceae: Peperomia pellucida (Linn.) H. B. and K. Piper hookeri Miq. P. trachostachyon (Miq.) C. DC.	Apr.—Sept	Vengurla, Sawant- wadi. Sawantwadi Sawantwadi
Myristicaceae Knema attenuata (Hook. F. and Thoms.) Warb.	# < #	Sawantwadi
Lauraceae Cassytha filiformis Linn. Alseodaphne semecarpifolia Nees.	Sept July—Dec	Vengurla Kudal
Litsea deccanensis Gamble L. stocksii Hook f	SeptOct.	Kankavali, Sawant- wadi. Sawantwadi
Neolitsea zeylanica (Nees) Merr. Cinnamomum verum Presl	••	Kudal, Sawantwadi Sawantwadi, Bhedshi.
Cryptocarya wightiana Thw.	Dec.—Apr	Sawantwadi

Name	Fl. Season		Locality
Persea macrantha (Nees)	••		Kankavali
Kosterm. Beilschmiedia dalzellii (Meissn.) Kosterm.	••		Sawantwadi
Thymelaeaceae: Lasiosiphon eriocephalus Deche.	DecMay	• •	Kankavali, Sawant- wadi.
Elaeagnus conferta Roxb			Kudal, Bhedshi
Loranthaceae: Viscum monoicum DC. V. angulatum Heyne ex DC. Macrosolen capitellatus (Wt. and Arn.) Danser.	Sept. All the year	••	Sawantwadi Kankavali, Bhedshi Kankavali, Bhedshi
Helixanthera wallichiana (Schult.) Dans.	••		Bhedshi
Scurrula philippinsis (Cham and Schl.) G. Don.	F-0		Kudal, Bhedshi
Helicanthes elastica (Desr.) Dans. Dendrophthoe falcata (Linn. f.)			Kankavali, Sawant- wadi. Kudal, Bhedshi
Etting. D. trigona (W. and A.) Dans. ex Sant.	Middle		Kudal, Bhedshi
Santalaceae Osyris wightiana Wall, ex Wt. Euphorbiaceae			
Euphorbia panchganiensis Blatt. and M. C.	यमेव जयते		
E. pycnostegiac Boiss	••		Kankavali, Sawant- wadi.
E. notoptera Boiss	Oct.—Dec.	• •	Deogad, Sawant- wadi.
E. parviflora Linn. E. hirta Linn. E. microphylla Heyn. ex Roth	••		Kankavali, Bhedshi Kudal, Bhedshi Sawantwadi
E. thymifolia Linn Phyllanthus emblica Linn	All the year Mar.—May	• •	Kankavali, Kudal Kankavali, Bhedshi
P. reticulatus Poir P. lawii Grah	All the year SeptOct.	• •	Kankavali, Bhedshi Kankavali, Bhedshi
P. urinaria Linn. P. virgatus Forst. f.	Aug.	• •	Sawantwadi Kankavali, Bhedshi
P. asperulatus Hutch Microcca mercurialis (L.) Bth.	••		Kudal, Sawantwadi Deogad, Sawant- wadi.
Tragia muelleriana var. Uni- color (M. Arg.) Pax and Hoffm.	••		Kankavali, Bhedshi Deogad, Bhedshi
Bridelia scandens (Roxb.) Willd.	••		Deogad, Sawant- wadi.
B. retusa (L.) Spr	May—Oct.	••	Kankavali, Bhedshi

Name	Fl. Season		Locality
B. squamosa (Lamk.) Graham Securinega virosa (Roxb. ex Willd.) Baill.	••	Deo	gad, Bhedshi
Actephila excelsa (Dalz.) M. Arg.	••		nkavali, Sawant- adi.
Glochidion velutinum Wt G. zeylanicum (Gaertn.) A. Juss.	Dec.—Mar. Oct.—June	Bhe	edshi ogad, Bhedshi
G. hohenackeri Bedd. Breynia refusa (Dennst.) Alston.	Dec.—Apr.		nkavali, Bhedshi nkavali, Bhedshi
B. vitisidea(Burm. f.) C. E. C. Fisch.:	• •		yantwadi, Bhedshi.
Croton oblongifolius Roxb. Agrostistachys indica Dalz. Dimorphocalyx lawianus	Feb. Mar.—Oct.	De Sav	ogad. vantwadi. nkavali,
(M. Arg.) Hook f. Blachia denudata Benth		S Ka	Sawantwadi. nkavali, Sawant- vadi.
Antidesmia acidum Retz. A. ghaesembilla Gaertn. A. menasu Mig. Sapium insigne (Royle) Bth.	May—July Feb.—May Dec.—Feb.	Ve Ku Kı	idal, Bhedshi ngurla idal, Bhedshi idal, Bhedshi
var. malabaricum (Wt.) Hook. f. Homonia riparia Lour.	Jan.—Apr.	Kı	Kankavali. ndal, Bhedshi
Macaranga peltata (Roxb.) M,-Arg. Drypetes venusta (Wt.) Pax	MART		wantwadi _I dal
and Hoffm. D. roxburghii (Wall.) Hurus. Mallotus philippensis (Lamk.) MArg.	Nov.—Jan.	Ka	udal, Bhedshi ankavali, Sawant- wadi.
M. stenanthus MArg M. aureo-punctatus (Dalz.): MArg.	SeptNov.		wantwadi ankavali, Vengurla
Irewia polycarpa Bth Aporusalindleyana Baill Jatropha gossypifolia Linn	Dec.—Feb.	M K	ankavali, Bhedshi [alwan. ankavali, Sawant- wadi.
J. curcas Linn. Pedilanthus tithymaloides (L.) Poit.		К	ankavali, Kudal
Ulmaceae: Holoptelea integrifolia (Rox Planch.	b.)	В	hedshi
Celtis cinnamomea Lindl. ex Planch. Irema orientalis (Linn.) Bl.			iwantwadi, Bhedshi. Iwantwadi,
•	**		Bhedshi.
Urticaceae: Boehmeria scabrella (Roxb.) Gaud. Debregeasia longifo lia (Burm	-		ankavali, Sawant- wadi. Deogad.
Wedd.	.)		-voeuv.

Name	Fl.	Season	Locality
Laportea interrupta(L.)Ch Girardinia zeylanica Decne	ew.	••	Sawantwadi. Kankavali, Sawant- wadi.
Pouzozia zeylanica (L.) Be	n n.		Deogad, Sawant- wadi.
Elatostema cuneatum Wt. Lecanthus peduncularis (Royle) Wedd.			Kankavali, Malwan Sawantwadi
Moraceae:			
Ficus tinctoria Forst. f. S parasitica Corn. var. parasitica Corn.	SP.	••	Kankavali, Vengurla
<i>F. heterophylla</i> Linn. f.		• •	Bhedshi
F. hispida Linn. f	• •		Deogad, Bhedshi
F. asperrima Roxb			Kankavali, Bhedshi
F. racemosa Linn	••	• •	Kankavali, Sawant- wadi.
F. benghalensis Linn.			Kankavali, Bhedshi
F. arnottiana Miq.	COTAL S		Deogad, Bhedshi
F. drupacea Thunb. vai.	CHIRL	10	Kankavali
pubescens (Roth) Corn.	2 55 20	695	
F. microcarpa Linn. f.	The state of the s	1292	Deogad, Bhedshi
F. tsjakela Burm. f.			Kudal, Bhedshi
F. amplissima J. E. Sm.	100000000000000000000000000000000000000	2009	Sawantwadi,
1	11 11 191	TY.	Bhedshi.
F. religiosa Linn. Artocarpus incisa Linn. f.	TALL	17	Kankavali, Kudal Sawantwadi,
Casuarinaceae: Casuarina equisetifolia J. and G. Forst.	R. संद्यमेव	(ट) नयंत	Bhedshi. Deogad.
MONOCOTYLEDONS			
Hydrocharitaceae			
Blyxa aubertii Rich.	• •	• •	Sawantwadi, Bhedshi.
B. echinosperma (C. B.	Cl.) July	Oct	Kankavali
Hoot. f.	_		
B. octandra (Roxb.) Plan Thw.	nch. ex	• •	Sawantwadi
Burmanniaceae: Burmannia pusilla (Wall Miers) Thw.	. ex	• •	Vengurla, Sawant- wadi.
Orchidaceae: Eria dalzellii Lindl.	••	••	Vengurla, Sawantwadi.
Cirrhopetatum fimbriatun	1	• •	Bhedshi
Lindi, Dendrobium ovatum (W	'illd.)	••	Sawantwadi
Kranz. <i>D.barbatulum</i> Lindl.	••	••	Kankavali, Bhedshi
	•		

Name		Fl. Season	Locality
D. crepidatum Lindl. D. lawianum Lindl. Oberoniu recurva Lindl.	••	••	Kudal, Bhedshi Kudal, Bhedshi Kankavali, Sawant-
Cottonia peduncularis (Lin	dl.)	• •	wadi. Sawantwadi.
Reichb. Aerides crispum Lind!. A. maculosum Lind!.		• •	Kudal, Bhedshi Sawantwadi
Acampe praemorsa (Ros Blatt and Mcc.		·	Kankavali, Bhedshi
Smithsonia viridiflora (Dal Sald.		••	Sawantwadi, Bhedshi. Kankavali,
Plantanthera susannae (Lin Lindl. Habenaria heyneana Lindl		, •	Sawantwadi. Sawantwadi
H. diphylla Dalz.	• • •	••	Kankavali, Sawant- wadi.
H. rariflora A. Rich. H. longicorniculata Grah.	••	• •	Sawantwadi Sawantwadi
H. panchganiensis Sant Kapad.	and		Sawantwadi.
H. marginata Coleb.			Kankavali, Sawantwadi, Sawantwadi
Peristylus densus (Lindl.) S and Kapad. P. stocksii (Hook. f.) Kra	8838		Kankavali
P. plantagineus Lindl.		tintal (Kankavali, Sawantwadi.
Eulophia epidendraea (R Fisch.	But	TIBL	Bhedshi
Malaxis versicolor (Lindl. Kapad.			Kankavali, Sawantwadi
Zingiberaceae:	सह	प्रमेव जयते	17 kanali
Costus speciosus (Koen.)		••	Kankavali, Sawantwadi
Curcuma neilgherrensis W C pseudomontana Grah.	٠.	••	Kudal, Bhedshi Kankavali, Bhedshi Kankavali,
C. decipiens Dalz.	••	• •	Sawantwadi.
Globba bulbifera Roxb.		• •	Kankavali, Bhedshi Kankavali
Zingiber macrostachyum I Alpinia nutans (L.) Rosco	јај2. е	••	Sawantwadi
Amomum microstephanum	Bak.	•••	Bhedshi
Hypoxidaceae			
Hypoxis aurea Lour.	4	* *	Kudal, Bhedshi
Curculigo orchioides Gaer	ın.	••	Sawantwadi, Bhedshi.
Amaryllidaceae: Crinum defixum Ker-Gaw	d.		Sawantwadi
Pancratium triflorum Rox	b.	••	Bhedshi
Taccaceae: Tacca leontopetaloides (L O. Kuntze.	inn,).	mag (1)	Kankavali, Vengurla.

Name	Fl. Season	Locality
Dioscoraceae: Dioscorea bulbifera Linn. D. belophylla Voigt D. oppositifolia Linn. D. pentaphylla Linn.	••	Deogad, Bhedshi Sawantwadi Kankavali, Bhedshi Kankavali, Bhedshi
Dracaenaceae: Dracaena terniflora Roxb		Kudal, Bhedshi
Liliaceae: Asparagus racemosus Willd. Gloriosa superba Linn. Iphigenia indica (L.) A. Gray ex Kunth. Ophiopogon intermedius Don.		Kudal, Bhedshi Kankavali, Sawant- wadi. Malwan, Sawantwadi. Sawantwadi
Var. parviflorus Hk. f. Chlorophytum orchidastrum Lind. C. breviscapum Dalz. Urginea indica (Roxb.) Kunth		Malwan, Sawantwadi. Sawantwadi, Bhedshi. Kankavali
Smilacaceae: Smilac zeylanica Linn		Kudal, Sawantwadi
Pontederiaceae: Monochoria vaginalis (Burm.) Presl.		Sawantwadi, Bhedshi.
Xyridaceae: Xyris pauciflora Willd	यमेव जयत	Kankavali, Sawantwadi.
Commelinaceae: Amischophacelus axillaris (L.) Rao and Kamm. Commelina diffusa Burm. f. C. hasskarlii C. B. Cl.: C. maculata Edgw. C. suffruticosa Bl. C. paleata Hassk.		Malwan, Deogad Sawantwadi Sawantwadi Sawantwadi Sawantwadi Deogad,
Cyanotis concanensis Hassk. C. fasciculata (Heyn. ex Roth) Schult. f. C. cristata (Linn.) D. Don.	 	Sawantwadi. Sawantwadi Deogad, Sawantwadi. Deogad, Sawantwadi.
Floscopa scandens Lour Murdannia semeteres (Dalz.) Sant. M. elata (Vahl) Bruckn		Sawantwadi Deogad, Sawantwadi, Kankavali, Sawantwadi,
M. simplex (Vahl) Brenan M. versicolor (Dalz.) Bruckn.	••	Kankavali, Bhedshi Kankavali, Sawantwadi.

Name	Fl. Season	Locality
M. dimorpha (Dalz.) Bruckr M. nudiflora (I.) Brenan		Sawantwadi Kankavali, Sawantwadi,
M. vaginata (L) Bruckn. M. spirata (L) Brucka.	••	Malwan. Kankavali, Bhedshi
Arecaceae: Calamus pseudotenuis Becex Bece, and Hook, f.	e	Sawantwadi, Bhedshi.
Pandanaceae: Fandanus furcatus Roxb.		Bhedshi
Typhaceae: Typha angustata Bory, Charet al.	nb	Kankavali
Araceae:		
Cryptocoryne retrospiralis:	• •	Kankavali
(Roxb.) Fisch. Theriophorum indicum (Dalz		Sawantwadi
Engl. Ariopsis peltata Nimmo Arisaema tortuosum (Wall.)		Kuda!, Sawantwadi Kankavali, Bhedshi
Schott. A. neglectum Schott. Amorphophallus campanulat	us	Sawantwadi Kudal.
(Roxb.) Bl. ex Decaisne. A. commutatus (Schott) Eng Remusatia vivipara (Roxb.) Schott.	gl	Kudal, Sawantwadi Sawantwadi
Pothos scandens Linn.	Cities III Company	Sawantwadi,
Colocasia esculenta (Linn.) Schott	सन्यमेव जयते	Bhedshi. Kankavali
Alismataceae : Wiesneria triandra (Dalz.) Michel.		Deogad, Malwan
Eriocaulaceae:		
Eriocaulon dalzellii Koern	• ••	Malwan, Sawantwadi.
E. xeranthemum Mart.		Kankavali, Sawantwadi.
E. stellulatum Koern.		Sawantwadi
E. cinereum, R. Br	••	Kankavali, Malwan
E. elenorae Fyson	••	Sawantwadi Kudal.
E. quinquangulare Linn. E. dianae Fyson var.	••	Kankavali,
longibracteatum Fyson.	••	Sawantwadi.
E. lanceolatum Mig.		Kankavali, Malwan
E. wightianum Mart.	••	Sawantwadi
E. thomasi Fyson	••	Kankavali, Sawantwadi.
<i>E. sedgwickii</i> Fyson	••	Sawantwadi

Name		Fl. Season	Locality
E. odoratum Dalz.	• •		Deogad,
E. cuspidetum Dalz.			Sawantwadi. Deogad, Malwan
E. sexangulare Linn.	•••	• •	Kudal
E. dianae Fyson	• •	• •	Kankavali, Bhedshi
E. robusto-brownianum Ru	ıhl.	• •	Sawantwadi
Cyperaceae:			
Scleria lithosperma (L.) S			Same-tund:
S. levis Retz.	w.	• •	Sawantwadi Swantwadi,
S. ICHS IQUE.	••	• •	Bledshi.
S. terrestris (Linn.) Fass.			Sawantwadi
Carex filicina Nees var.	••	• •	Kankavali
glaucina (Boeck.) Kuck		• •	
Eleocharis retroflexa (Poir		• •	Sawantwadi,
Urb.	-		Bhedshi.
E. geniculata (L.) R. and	S.		Kudal
Rhynchospora wightiana (Nees) Stud.		••	Kudal, Sawantwadi
Scirpus articulatus Linn.	5	THE STATE OF THE S	Kankavali,
	SIN		Sawantwadi.
S. juncoides Roxb.	5N945		Kudal
S. lateriflorus Gmel.	7443	子都是	Deogad,
	SSME		Sawantwadi.
Fuirena ciliaris (L.) Roxb.	Spilet	162440°	Kudal, Bhedshi
F. uncinata Kunth.	-¥ /\.i	TUH!	Kudal
Fimbristylis schoenoides	1.90	1 24 1	Kankavali
(Retz.) Vahl.	AL STATE	7 2017 20	V11:
F. acuminata Vahl	10.2	881777.	Kankavali,
F. tetragona R. Br.	is only		Sawantwadi. Kankavali, Kudal
F. littoralis Gaud.			Kankavali, Kudal Kankavali,
1. Illiorans Gaac.	स्यम	ाव जयत	Bhedshi.
F. woodrowii C. B. Cl.			Kankavali
F. ferruginea (L.) Vahl			Kankavali,
			Sawantwadi.
F. dichotoma (L.) Vahl	• •	• •	Kankavali,
			Sawantwadi.
F. cymosa R. Br.	• •	• •	Malwan
F. argentea (Rottb.) Vahl	• •		Sawantwadi
F. ae .tivalvis (Retz.) Vahl	• •	• •	Malwan, Bhedshi
Cyperus kyllinga Endl.	• •	• •	Sawantwadi
C. leucocephalus Retz.	• •	• •	Kankavali,
C. brevifolius (Rottb.) Has	e k		Sawantwadi. Kudal, Sawantwadi
C. arenarius Reiz.	JK.	• •	Deogad
C. maderaspatanus Willd.	• •	• •	Malwan,
C. Marier was a same	•	• •	Sawantwadi.
C. paniceus (Rottb.) Boeck	•	• .	Malwan, Sawant-
			wadi.
C. javanicus Houtt.	• •	• •	Kudal
C. pangorie Rottb.	• •	• •	Kankavali, Bhedshi
C. exaltatus Retz.	• •	• •	Sawantwadi
C. rotundus Linn.	• •	• •	Bhedshi
C. distans Linn. f.	• •	• •	Kankavali,
			Sawantwadi.

Name	Fl. Season	Locality
C. iria Linn. C. alulatus Kern. C. compactus Retz. C. squrrosus Linn. C. halpan Linn. C. tenuispica Steud C. pumilus Linn. C. sanguinolentus Vahl. C. diaphanus Schrad ex Roem	••	Deogad, Sawantwadi Malwan Kudal Deogad Kudal, Bhedshi Kankavali, Bhedshi Kankavali, Bhedshi Kankavali
poaceae:	•	
Dendrocalamus strictus (Roxb.) Nees.	• 0	Kankavali, Bhedshi
Bambusa arundinacea (Retz.) Roxb. Coix lachryma-jobi Linn		Sawantwadi, Bhedshi. Kankavali, Bhedshi
Spinifex littorens (Burm. f.)	•••	Malwan
Merr. Dimeria blatteri Bot D. santapaui Alm. D. woodrowii Stapf. D. stapfiana C. E. Hubb. ex		Sawantwadi Malwan Deogad, Malwan Kankavali, Bhedshi
Pilg. D. gracilis Nees ex Steud. D. hohenackeri Hochst. ex Miq.	Braully	Kankavali, Bhedshi Kankavali, Bhedshi
D. ornithopoda Trin. Pogonachne racemosa Bot Spodiopogon rhizophorus (Steud.) Pilg.		Kankavali Kankavali Kankavali, Sawantwadi. Kankavali, Bhedshi
Saccharum spontaneum Linn.: Eulaila fimbriata (Hack.) O. T. Kuntze.	यमेव जयते	Kankavali
E. trispicata (Schult.) Henr. Hackelochloa granularis (L.)		Sawantwadi. Kankavali. Deogad
O. Kuntze. Manisuris clarkei Bor apud.	••	Kankavali
Sant. M. ratnagirica Kul. and Hem. M. forficulata fisher M. mysorensis Jain and Hem. M. santapaui Jain and Desh. M. goaensis Rao. and Hem. M. acuminata (Hack.) O.	••	Sawantwadi Kankavali, Bhedshi Sawantwadi Deogad, Malwan Bhedshi Deogad, Bhedshi
Kuntze. M. acuminata var. woodrowii	••	Bhedshi
Bor. M. acuminata var. stocksii	s •	Kankavali, Malwan
(H. k. f.) Jain. Ischaemum indicum (Houti.) Merr.	• •	Kankavali, Bhedshi
I. timorense Kunth I. commutatum Hack. I. razadae Bill. and Hem. A-127—33-A.	••	Kankavali, Bhedshi Kudal, Sawantwadi Sawantwadi

Name		Fl. Season	Locality
I. impressum Hack. I. mangaluricum (Hack.) Stap. f. ex Fisch.	••	••	Sawantwadi Kudal, Bhedshi
I. santapaui Bor I. travancorense Stap. f. ex Fisch.	••	••	Kankavali, Kudal Kudal, Sawantwadi
I. tumidum Stapf ex Bor I. dalzellii Stapf ex Bor	••	••	Kankavali, Bhedshi Kankavali, Bhedshi
I. semisagittatum Roxb. Apluda mutica Linn.	••	• •	Bhedshi Kankavali, Sawantwadi.
Chrysopogon aciculatus (Retz.) Trin.			Kankavali, Sawantwadi.
C. orientalis (Desv.) A. Ca C. fulvus (Spreng.) Chiov. Arthraxon jubatus Hack.		••	Sawantwadi Bhedshi Sawantwadi
A. lancifolius (Trin.) Hoch: A. lancifolius var. hindustar		* *	Kankavali, Sawantwadi.
Jain and Desh.	исиз.		Malwan, Bhedshi
A. nudus (Steud.) Hochst.	STATE OF		Malwan, Sawant- wadi.
A. raizadae Jain, Hem. and Desh.	i		Malwan, Sawantwadi.
A. prinoides (Steud.) Dan. A. meeboldii Stapf.	CONTRACT OF THE PARTY OF THE PA		Malwan, Sawantwadi. Konkan
Capillipedium assimile (Steud.) A. Cammus	4	FIFE	Konkan
C. filiculme (Hook. f.) Stat Dichanthium annulatm (Forssk.) Stapf.	of.		Konkan Malwan
D. caricosum (L.) A. Cami	IS.	त जयते	Kankayali
Schizachyrium paranjpyean (Bhide) Raiz. and Jain.		ન નાનવ	Sawantwadi
Bhidea burnsiana Bor	• •	• •	Malwan
Themeda triandra Forsk. T. quadrivalvis (Linn.) O. Kuntze.	• •	••	Kankavali, Bhedshi Kankavali, Bhedshi
T. tremula (Nees ex Stend) Hack.		••	Kankavali, Sawantwadi.
Heteropogon contortus (L.) Beauv.)	• •	Deogad, Bhedshi
Pseudodichanthium serrafal coides (Cooke ex Stapf.) Bor		••	Sawantwadi
Panicum trypheron Schult.			Sawantwadi
P. paludos Roxb.	• •	••	Deogad, Sawant- wadi.
P. repens Linn	• • • • • • • • • • • • • • • • • • •	• •	Kankavali
P. sumatrense Roth ex R. a	ana S.		Sawantwadi Kankayati Mal
P. psilopodium Trin. P. notatum Retz.	• •		Kankavali, Malwan Kankavali,
1. notatam 1002.	••	••	Sawantwadi.
Cyrotococcum trigonum (R A. Camus. A-127—33-B.	etz.)	••	Sawantwadi, Bhedshi.

Name	Fl. Season	Locality
C. oxyphyllum (Steud) Stapf.	••	Kankavali,
Sacciolepis interrupta (Willd.) Stapf.	• •	Sawantwadi. Sawantwadi
S. myosuriodes (R. Br.) A. Camus.	••	Bhedshi
Setaria glauca (L.) Beauv. S. italica (L.) Beauv.		Kankavali, Bhedshi Kudal
Echinochloa colonum (L.) Link.	•••	Kankavali, Bhedshi
E. frumentacea Link Opliamenus burmannii (Retz.) P. Beauv.	••	Deogad, Malwan Kankavali, Bhedshi
O. compositus (L.) Beauv.	••	Kankavali, Sawantwadi.
Paspalidium geminatum (Forssk.) Stapf.	• •	Deogad
Paspalum compactum Roth P. scrobiculatum Linn	••	Sawantwadi Kankavali
Brachiaria ramosa (L.) Stapf. Digitaria stricta Roth ex	FEE	Kankavali Kankavali Bhadahi
R. and S.		Kankavali, Bhedshi
D. abludens (R. and S.) Veldk. D. ciliaris (Retz.) Koel. Alloteropsis cimicina (L.)		Deogad Malwan, Bhedshi Kudal
Stapf. Pseudoraphis spinescens (R. Bri) Vick.		Deogad
Centotheca lappacea (L.) Desv. Eragrotis japonica (Thunb.) Trin.		Malwan Bhedshi
E. diarrhena (Schult.) Steud. E. gangetica (Roxb.) Steud. E. poaeoides P. Beauv.	व्यमेव नयने	Kudal Kankavali, Bhedshi Kankavali, Bhedshi
E. unioloides (Retz.) Nees ex Steud.	•••	Kankavali, Sawantwadi,
E. tremula Hochst. ex Steud, Elytrophorus spicatus (Willd.) Camus.		Malwan Bhedshi
Eleusine indica (L.) Gaertn. E. Coracana (L.) Gaertn.	••	Malwan. Kankavali
Dactyloctenium aegyptium (L.) Beauv.	••	Sawantwadi, Bhedshi.
Oropteium villosulum Stapfet Bor.	••	Deogad, Malwan
Chloris montana Roxb Danthonidium gammei Bhide Jaub.	• •	Malwan Sawantwadi
Oryza sativa Linn	••	Kankavali, Sawant- wadi.
Isachne globosa (Thunb.) O. Kuntze.	• •	Deogad, Sawant- wadi.
Coelachne simpliciuscula (W. and A.) Munro ex Bth.	••	Sawantwadi
C. perpusilla (Arn. ex Steud.) Thw.	••	Sawantwadi

Name	Fl. Season	Locality
Arundinella leptocheoa (Nees ex Stend) Hook, f.	• •	Kankavali, Bhedshi
A, pumila (Hochst.) Stend.		Kankavali
A. nepalensis Trin	• •	Kankavali
A. metzii Hochst. Mig	••	Kankavali, Sawantwadi.
Jansenella griffithiana (C. Muell) Bar.	• •	Kankavali, Bhedshi
Garnotia tenella (Arn. ex.	• •	Sawantwadi
Mig.) Janowskn. Sporobolus piliferus (Trin.) Kunth.	••	Sawantwadi
S. virginicus (L.) Kunth.	• •	Malwan
Aristida adscensionis Linn.	••	Malwan
A. redacta Stapf.		Kankavali
A. setacea Retz	• •	Kankavali, Bhedshi
Zoysia matrella (L.) Merr.		Malwan
Perotis indica (L.) O. Kuntze		Malwan
Indopoa paupercula (Stapf.)	• •	Kankavali,
Bor.	estrates.	Sawantwadi.
Tripogon capillatus Jaub. ex	138122	Sawantwadi
Spach. T. lisboae Stapf		Kankavali, Sawantwadi.

11.2. Hot Water Springs of Ratnagiri:

Hot water springs are seen at several places in Ratnagiri district around Sangameshwar and at Chiplun, Khed, Unhala, Aravali, Tural, Rajawadi and Rajapur. Most of them give out bubbles containing CO₂ and H₂S, their temperature ranges from 35.5°C to 69°C. The flow of water is maximum, 1870 gallons per hour in Rajawadi springs, but only 240 gallons per hour in Khed springs. The Rajapur springs are near Unhala village. Their temperature is 42°C. None of these and other minor ones have been botanically surveyed. Of these the hot water springs at Unhala having a temperature of 69°C have radons m. Mc. 0.806 per litre of water. This spring has the largest flow of water 1500 gallons per hour. Other springs are not reported to have radons.

The water of these hot springs is supposed to cure rheumatic pains and skin diseases.

11.3. Mangroves of Ratnagiri and Sindhudurg Districts.

A unique feature of Konkan vegetation and flora is mangroves. They comprise plants growing in marine saline mud flats or in semi-muddy situations of estuaries along the west coast of India touching the Arabian sea. They extend from Malaya, Burma, Chittagong, Calcutta to Kakinada, Madras, Kerala, through Goa and Karwar to Konkan, Bombay and Saurashtra coast. Similar mangroves are seen in other parts of the world in the Eastern Tropics, upto Australia, but their highest concentration is in Malaya, and next to that in India. A few occur on African and on Australian coast. Broadly speaking they are the plants of Eastern Tropics not found in temperate countries. They have special features of their own; for example, they seem to be lush green always, although they grow in situations which are physiologically dry. This is because they grow in places where humidity is very high throughout the year along the coast and estuaries of rivers penetrating in the interior.

In Maharashtra they extend from Terekhol river to Ratnagiri, from Bombay to Par river separating South Gujarat from Maharashtra. There are in all about 12 mangroves in Maharashtra, particularly on the Konkan coast. Table 11.4 gives the mangroves of Ratnagiri and other Konkan areas.

A number of botanists have studied them and their biology (Cooke, 1903; Blatter, 1905; Bharucha and Karnik, 1960; Navalkar, 1966-67). Some mangroves have stilt roots e. g. Rhizophora mucronata detailed review see Joshi et al. 1975, Blasco 1977). Some grow rooted in saline mud. They are washed by sea water twice a day. Their leaves are green and fleshy. Mullan (1931) examined their anatomy and found that they have distinct water storage devices. The osmotic pressure in their root and leaf cells is higher. Some of them use quite an amount of water despite unavailability of fresh water. How this happens and why do they not get desiccated was a problem that took nearly 40 years to get solved. Dr. G. V. Joshi (1973) worked on their mineral absorption, salt resistance and photosynthesis. He found that they all are not equally salt tolerant, but that they absorb it selectively and have different ways of retaining or excreting or balancing excess of salt. There are three categories in them: (i) Salt excluding mangroves: Rhizophora mucronata, Ceriops tagal, Bruguiera gymnorhiza, Candalia These plants exclude salt in their absorption. (2) Salt excreting mangroves: Avicennia officinalis, A. alba, Acanthus ilicifolius. (3) Salt accumulating mangroves: These absorb salt (NaCl) but balance it by absorbing ions of other elements such as Potassium or Calcium e. g. Sonneratia acida, S. apetala, Lumnitzera racemosa, Excoecaria agallocha.

Here the functioning of cell membranes plays an important part in salt absorption and salt excretion. Their photosynthesis also has a number of peculiarities; one is that the sodium chloride interferes with the photosynthesis process. The soils here have due proportion of potassium and calcium, but excessive calcium very often tends to inhibit growth and absorption of other constituents. As a matter of fact salt logged soils absorb more of calcium and excessive sodium chloride invariably. This process leads to more calcium being absorbed as in the Chopan soils along the Deccan canal in Sholapur, Baramati and other places in Maharashtra, and in Ussar soils in Uttar Pradesh. We have already seen that sodiumization is preliminary to calcification of soils, thereby rendering them infertile. In some mangroves there is dual mechanism for photosynthesis, C_3 and C_4 .

Generally in rainy season salts in these soils get leached out and they become better. In other soils there is intake of fresh water due to rivers flowing through them to sea. However there is heavy evaporation in summer months and salt accumulates again, and the soils become rich in salt. Rhizophora mucronata grows in sea water containing the highest concentration of salts, whereas Sonneratia and Excoecaria agallocha grow in water with the lowest salt content, usually on the banks of rivers joining sea, where salt is the least. Still further away from the marine coast, in areas where there is a continuous influx of fresh water. plants of Acanthus ilicifolius, Tylophora dalzellii, grow. Cyperus and grasses like Alepecoros also grow. They are least tolerant of salt; practically they are the dwellers of fresh water marshes behind the mangrove vegetation.

Thus one sees zonation in mangrove vegetation in salt rich areas on Terekhol and in less salty areas like Chiplun on the banks of Vashishthi river. The salt is less here due to influx of fresh water and less dominance

of other mangroves. The analysis of sea water and its principal mineral constituents is given elsewhere. The mangrove soils have higher percentage of salt than sea water. The salt tolerance develops slowly. Excepting Avicennia alba, other mangroves do not have salt glands on their leaves. Therefore, they have to adopt different mechanisms for the retention of water.

The third important feature of mangroves is vivipary. This is very nicely seen in Rhizophora mucronata which forms fruits on the plant and seeds germinate on tree sending down long stout radicle a part of which is retained by the fleshy fruits. Bruguiera gymnorhiza has also viviparous fruits. A number of lenticels develop on the radicle before the fruit is separated from the parent plant and starts germinating in mud as an independent plant. It slowly develops salt tolerance. It is not a property ab initio but is acquired secondarily till they are able to withstand rich salt content in soils. The embryo of Avicennia has no long radicle; the embryo with a large cotyledon is released from fruit and falls on the soil near the salt marshes or rocky coastal puddles and germinates there. Secondly its leaves have water glands on them and result in high rate of respiration. Some mangroves such as Avicennia officinalis, and A. alba develop woody pneumatophores which come above the surface of the soil and help in breathing. They are seen around the plant in mud. Some of them have regular form, and others are twisted. But they all are apogeotropic. A few form even the knees e. g. Marsh Cypers or *Podocarpus*. But these two mangroves do not occur on our coasts.

The fourth important character of mangroves is the higher number of stomata on leaves per mm² as compared to those of succulents like Aloe (20), Calanchoe (32-40), Portulaca (48---89), on the upper and the lower surface of leaf. Of these Kalanchoe and Aloe are Crassulacean succulents. Another characteristic feature of all mangroves is that their stomata remain open during early hours of the day and close with increase in the intensity of sunlight after dawn. They also open slightly in the evening. This suggests that the maximum photosynthetic assimilation in mangroves takes place between 8 a.m. and 10 a.m. At high temperature since the stomata close down, carbon assimilation in them at noon, is not possible. Salt tolerance is also developed by marine algae like Cladophora, Ulva, Sargassum and by animals like Crustacea,

With all these adaptations mangroves seem to be not only dominating plants along sea coast, but they seem to thrive, and keep green our coast line. In all there are about 30—50 such plants world over, and about 25 in India. A huge proportion of them is seen in the Sunderbuns at the mouth of Hoogli river. Two special mangroves are Heretiera maritima or Sundari and Nypa fruticans the floating palm of marshy areas along the sea coast. Another palm that occurs there is not strictly a mangrove or a dweller of heavy salt laiden areas, Phoenix paludosa. Both these palms do not occur in Konkan area, but are plentiful in Sri Lanka, Calcutta, Rangoon, etc.

On Konkan coast very few marine grasses are present, but at Vengurla, Malwan many are present. There is also found a marine grass Anhalus maritima. The sea shore here is extremely rocky and forms ponds. At Kakinada on the East coast in Andra Pradesh, the number of mangroves is less than in Konkan, but the relative proportion of plants f a species is more.

Mangroves are economically important as their bark is a rich source of tannin for which they are much prized. At Madras and other places there is a great demand for their bark by tanners. They also prevent soil erosion. They are an edaphic climax plant community.

The Konkan coast all along is neither rocky nor sandy like the Madras coast. It is both sandy and rocky. Behind the rocks on sands there is another plant community the sand binders. In the depressions in rocks along the sea coast, soil gets accumulated and on it the strand plants grow. Sometimes in such soils at some places salt accumulates and the land becomes unfertile. Such soils are called Khar lands. They occupy pretty large disconnected areas from Sawantwadi to Surat and even on Saurashtra coast. Government is trying to reclaim the Khar lands with a view to increase cultivation.



11.4. DISTRIBUTION OF MANGROVES IN RATINAGIRI AND OTHER KONKAN AREAS

		Relative, Gominance at	ominance at	Inorga	nic const Chi ₂ lu	constituents of ma Chiplun (Vashistai)	Inorganic constituents of mangroves at Chiplun (Vashistai)	ves at			Terekhol	10	
Serial Name No.	•	Chiplun (Vashisthi)	Terekhal	Z Z	꿏	ర	ס	Nak	Na	*	් ප්	ס	Z
(1) (2)		(3)	<u>4</u>	(5)	(9)	3	(8)	(6)	(10)	(11)	(12)	(13)	(14)
Sonneratiaceae : 1 Sonneratia acida	:	Rare	Соттоп	96:0	0-92	1.18	2.04	Ξ	2.04	1.44	1.56	4.12	4-1
2 Sonneratia apetala	:	Dominant	Rare	:	:	<	:	:	:	:	:	:	:
Rhizophoraceae: 3 Rhizophora mucronata	:	Common	Dominant	1.6	0.48	0.75	2.9	3.3	2.44	92.0	1-14	4-41	3.2
4 Kandelia rheedei	:	Less Commo	Less Common Less Common	0.72	1.24	0.85	2.27	9-0	2.0	0.84	89.0	2.84	5.4
Myrsinaceae: S Aeguiceras majus	:	Common	Common	0-48	0.4	0.27	0-71	1.2	1.72	6.0	0.5	2:27	1.9
Berbenaceae : 6 Avicennia alba	:	Rare	Dominant and pare) :	:		>	:	:	:	:	:	:
7 Avicennia officinalis	;	Common	patches.	1.6	1.08	0-44	2.12	1.5	2.76	1.12	0-84	3.2	2.5
Acanthaceae: 8 Acanthus ilicifolius	:	Dominant	Common	99-0	2.4	1.28	3-33	63	2.68	1.64	1.12	5.11	1.6
Euphorbiaceae : 9 Excoecaria agallocha	:	Common	Very common	0.3	0.52	1.8	0.57	0.5	8 0	1.9	1.72	2.56	0.4
Papilionaceae: 10 Derris wliginosa	:	Rare	Rare		:	:	:	:	:	:	:	:	:
N. B.—It will be seen that the	at the	lifferent mangro	ifferent mangroves have different proportion of inorganic ions, and different distribution depending on their salt clearance.	proport	ion of inc	rganic io	ns, and d	fferent d	istributio	n depend	ling on th	eir salt c	learano

11 5 Strand Plants:

Principal forests in Konkan are along the lower slopes of hills, before the plain begins and behind the littoral swamps and sands near the coast line. Behind them and along the banks of rivers joining the creeks they occur. At high tide mark some plants are daily inundated by sea water and some only twice in a month when high tide incurs far behind the sea coast line. Behind these the soil is collected in the depressions of creeks. Thick strands of trees form a continuous belt of vegetation behind the mangroves in a number of places. As we go farther towards interior there are trees forming discontinuous canopy. At the fringe of the forests there are shrubs and under-shrubs. The sea coast however is sometimes interrupted by Sahyadri ranges reaching right upto and inside sea as, at Jawhar, Alibag or Terekhol. But generally there are littoral swamps behind the rocky sea shore or sands.

Mangroves grow here. At other places the seashore is sandy and forms long stretches of sandy belts as at Dahanu, Ratnagiri or Karwar. At Saviku near Chiplun there are sand bars but all places near Terekhol river are getting silted up. Here we get strands of Casuarina or Calophyllum inophyllum. At places there is a regular mixed forest having some woody creepers on trees such as Barringtonia speciosa and Barringtonia acutangula, Calophyllum inophyllum, Thespecia populnea mixed with Lumnitzera racemosa and Sonneratia acida. Some grasses and hedges, Derris uliginosa, Combretum ovalifolium, Caesalpinia nuga, Dalbergia spinosa, Xylocarpus obovatus, Pandanus furcatus, Pandanus odoratissimus, Gnetum ula are found. If the soil collected is not washed away, a regular small belt of forest is developed behind the mud flats as at Ratnagiri or Ghod Bunder.

On the banks of rivers mangroves and seashore plants get salted out in zones according to the proportion of salt present in the mud, banks of rivers, creeks and salt tolerance of the species.

In some places there is always intake of fresh water and species which are not tolerant of strong saline conditions. Their plants become succulent. Some of them are never to be seen in places where sea water is rich in salt content and inundates them. So they are away from sea coast. e. g. Acanthus ilicifolius, Tylophora dalzellii, Aloe barbadense, Asparagus racemosus. These are typical plants behind the mangroves Sonneratia apetela, Sonneratia acida, Avicennia officinalis. In the fore-ground of them grow Exoaecaria agallocha, Avicennia officinalis, Carapa obovata. As the summer proceeds the proportion of salt content in the wet mud increases and by that time the plants therein get adapted and develop tolerance to higher percentage of salt. Here on the fringe one notices Salvadora persoca, grasses like Spinifex squarrosus, and Clerodendron inerme. In such situations even these plant species show succulence.

Where the fresh water percolates more we get forest tracts having Sterculia guttata, Erythrina sp. Dalbergia latifolia, Bauhinia malabarica etc.

Where the sea is sandy or rocky, and not muddy, there are a number of sand binders Ipomoea biloba, Suaeda maritima, Spinifex squamosus, Pandanus odoratissmus, Cressa cretica, Portulaca oleracea, Launea nudicaulis, Lepidagathis cristata, Pedalium murex, Sida veronicifolia, Sesuvium protulocastrum, Erythrina stricta, Orthocnemum indicum. Sporobolus glaucifolius, Salicornea bracheata and other species.

The most tolerant of high percentage of salt in saline situations is Rhizophora mucronata, and where it is the least Sonneratia apetala, Acanthus ilicifolius, Excoecaria agallocha grow and occasionally Kandielia candel. On the Bombay coast Avicennia alba is dominant and occurs in pure stretches. The other species Avicennia officinalis or A. maring is common elsewhere. Some mangroves can also grow in fresh water e. g., Acanthus ilicifolius.

12. FLORA OF KANKAVALI

Kankavali is a taluka place about 40 kilometres to the east of Malvan having an old temple of Kanakeshwar on a range of Sahyadri. Being on a hillock, it has equable climate throughout the year. It receives about 2286—2540 mm. rain every year, a little more than Bombay. The number of rainy days is 100, from 2nd week of June to end of September. The soil is mostly lateritic, rather poor in Nitrogen. There is good forest as the hill above the Konkan plain, but the growth of trees in spite of the continuous humidity is not much. Teak (Tectona grandis) forms forest rather of a poor type. Bambusa arundanesia, Dillenia pentacyna, Terminalia chebula, T. cranulata, T. bellirica, Legerstroemia sp. Mangifera indica, Saraca indica, Bauhinia vahlii, Vitis woodrowii, Holarrhena antidysenterica are the chief constituents. Among the bushes prominent are Capparis sepiaria, Barleria courtallica, Sida rhombifolia, Euphorbia ligularia, Ixora coccinea.

The flora is a mixture of moist deciduous and dry deciduous types. It was worked out by A. N. Namjoshi and Dr. B. G. Kulkarni. It is given by Ezakiel (1947). The plants of the main areas are noted below.

Plants of Kankavali Hills:

The flora of Kankavali hills is concentrated in six localities all around the temple of Kanakeshwar, viz.(i) plants in the vicinity of the Kanakeshwar Temple proper, (ii) around Kaivalyadham, (iii) on western slopes, (iv) on north-western slopes, (v) Danda area, and (vi) Vyagreshwar Plateau. 80 per cent of flora has been covered and enlisted by A. N. Namjoshi and given by M. Ezakiel (1947).

The most dominant plants forming upper canopy are Mangifera indica, Saraca indica, Bauhinia vahlii. The second story is formed by Calophyllum inophyllum, Terminalia chebula, T. bellerica. On Vyagreshwar side one notices Alseodaphne semicarpifolia, Erythrina indica, Anodendron paniculatum, Gnetum ula (G. Scandans) is abundant in Danda area which also contains other woody creepers. This suggests moist deciduous forest. On the other hand, on the north-western slopes one notices Euphorbia ligularia as the dominant bush. Near the temple itself, there is good vegetation consisting of about 125 species. Among them Anacardium occidentale, Anogeissus latifolia are very prominent and abundant. A number of shrubs like those of Memecylon umbellatum form the second layer. On the ground there are several members of Acanthaeceae, Compositae, tuberous monocotyledons. Carissa carandas (=C-Congesta). Calicopteris floribunda occur at the fringe of the forest. During the rainy season grasses and bulberous lilies and two ferns Adiantum lunulatum and Athyrium hohenakaryanum grow in sandy places. The vegetation thus seems to be of moist deciduous type in certain areas on north-western slopes and of deciduous woodland type in others. This is largely due to the soil being washed away by heavy rains on hill slopes. Moist species grow on soils where debris is gathered in valleys. Among the important plants noteworthy are

Terminalia arjuna, Acacia catechu, A. concinna, Pterospermum acerifolium, Holarrhena antidysenteriea. Around Kaivalyadham Ashram, Saraca indica, Sterculia colorata, Ficus heterophylla, Ixora concinna are seen. On the western slopes, Eugenia jambolana, Vitis woodrowii, Alysicarpus vaginalis, Pavatta indica are dominant. On the western slopes Euphorbia ligularia, Calycopteris floribunda, Alysicarpus vaginalis are abundant. On the northern slopes and in Danda area there are many creepers like Symphorema involucrata, Capparis horrida, Smilax macrophylla, Cansjera rheedii, Vitis repanda. Terminalia bellerica, T. chebula and Dillenia pentagyna, Ochrocarpus longifolius, guttata, Garuga pinnata, Pterocarpus acerifolium seem to be dominant. Species of Bridelia, Zizyphus and Leea microphylla are dominant. On north-western slopes there is not much soil and only tuberous plants like Curculigo orchioides, Chlorophytum tuberosum and parasitic Aeginetia indica grow on a number of shrubs. Considered as a whole the flora of Kanakeshwar despite high humidity is a thorn savannah on the slope of hills and of moist deciduous type in the valleys on western slopes.

13. ISLANDS IN ARABIAN SEA ALONG THE COAST OF KONKAN

There are more than 100 islands in Arabian sea all along the west coast of India, lying at a variable distance off the coast. They are also of variable size. They are important from the view points of coastal defences, oil and gas resources, commerce and sea traffic. They occur in two sub-groups:—

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- (A) Bombay sub-group consisting of 7 islands.
- (B) Malvan sub-group of 6 islands.
- (A) The Bombay sub-group (18°55'N., 72°.54'E.)-
 - (1) Elephanta island or Gharapuri.
 - (2) Butcher's island.
 - (3) Armoury island.
 - (4) Nhava island.
 - (5) Sheva island.
 - (6) Manori island.
 - (7) Madh island.
- (B) Malvan sub-group (16°.3'N, 73°.28'E)—
 - (1) Kawade Bakal.
 - (2) Devatara.
 - (3) Pad magad.
 - (4) Sindhudurg.
 - (5) Vengurla oyster rocks.
 - (6) Redi Fort Basin Islet.

Of these the plants of Elephanta have been recently surveyed by Dr. A. C. Untawale of National Oceanographic Institute, Goa.

Those of Madh Island had been earlier collected by Dr. G. L. Shah (1965) and by Dr. Untawale recently. He has also surveyed the islands along the coast of Gujerat, Saurashtra, Goa and Malabar.

The flora of these islands except those along the Saurashtra coast is in no way different from that on the mainland of Maharashtra facing opposite them. It is not endemic or insular. The flora is of the monsoon dry deciduous type. They are fringed or encircled by mangrove vegetation which is the same as on the west coast of India having sticky mud flats around. A detailed investigation of these islands was made under Dr. T. S. Mahabale and Dr. Untawale as a special project of the Indian National Science Academy, Delhi at the National Oceanographic Institute, Mira Mar, Goa. But their report is not yet published which might throw further light on the flora and fauna of them. One thing which appears to be certain is that they appear to have been separated from the mainland at no very distant past and have similar flora as is on the opposite mainland. Such is not the case with the islands opposite Saurashtra Coast, e. g. Piram Island.

Plants of Elephanta are already described previously and those of Malvan group are described under:—

13.1. Plants of Bakal Kauda Island near Malvan (also known as Kawade Bakal):

Papilionaceae:

Phaseolus radiatus L.

Cucurbitaceae:

Luffa acutangula Roxb.

Compositae:

Tricholepis glabarrina DC. Sphaeranthus africanus L.

Amarantaceae:

Aerua sanguinolanta (L.) Bl. Celosia argentea L.

Gramineae:

Ischaemum cupressum

Cyperaceae:

Cyperus rotundus L. Fimbristylis ferruginea (L.) Vahl.

13.2. Plants within the Sea Fort Sindhudurg near Malvan:

This is a very important well known sea fort, standing on a solid rock off the Malvan coast. The plants within its walls are given below:—

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Capparidaceae:

Capparis zeylanica L. Capparia hanida.

Portulacaceae:

Portulaca oleracea L.

Elatinaceae:

Garmis ammanioides Roxb.

Malvaceae:

Abutilon indicum (L.) Sw.

Urena lobata L.

Sida cordata (Burm. f.) Borss.
—Sida vernonicifolia Burm.

Papilionaceae

Indigofera cordifolia Hayne ex Roth.
Alysicarpus procumbens (Roxb.) Schindi.
Alysicarpus glumaceus (Vahl) DC.
Zornia diphylla (L.) Pers.
Desmodium triflorum (L.) DC.
Vigna radiata L.
Phaseolus radiatus L.

Caesalpinaceae Cassia pumila L.

Cassia absus L. Cassia tora L.

Lythraceae:

Ammania multiflora Roxb.

Rubiaceae:

Oldenlandia herbacea DC.

Compositae:

Vernonia cincrea (L.) Less.
Ageratum conyzoides L.
Synedrella nodiflora (L.) Gaertn.
Eclipta alba Hassk.
—Eclipta prostrata L.
Tridax procumbens L.
Centratherum minuticum.
Launea pinnatifida Cass.

Gentianaceae:

Hoppea dichotoma Willd.

Convolvulaceae:

Ipomoea pes-tigridis L.

Scrophulariaceae:

Centranthera indica (L.) Gamble. Centranthera hispida Br.

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Pedaliaceae:

Sesamum indicum L.

Acanthaceae:

Justicia trinervia Vahl. Achyranthus aspera L.

Labiatae:

Leucas lavendulifolia Sm.

Verbenaceae:

Vitex nigundo L. (v. trifolia). Lantana camera L.

Amarantaceae:

Celosia argentia L. Aerva lanata (L.) Juss. Alternanthera sesslis Br.

Loranthaceae:

Viscum nepalense Spreng.

—Viscum articulatum Burm.

Euphorbiaceae:

Ēuphorbia hirta L.

Urticaceae:

Laportea interrupta (L.) Chew. —Fleurya interrupta Gaud.

Commelinaceae:

Commelina benghalensis L.

Cyperaceae:

Cyperus sp.
C. pumilus L.
C. compressus L.
C. squarrosus L.
Fimbristylis argentea Vahl.

Gramineae:

Oplismenus burmannii (Retz.) Beauv.
O. compositus (L.) Beauv.
Eragrostis tenella (L.) Woodr.
E. japonica (Thunb.) Trin.
E. unioloides (Retz.) Nees ex Steud.
Heteropogon contortus (L.) Beauv.
Themeda triandra Forsk.
Ischaemum indicum Metr.
Spodiopogon rhizophorus (Steud.) Pilg.
Arthraxon lancifolius (Trin.) Hochst.
Ochlanda mutica L.
Eleusine indica (L.) Gaertn.

14. COMPARISON OF THE FLORA OF KONKAN DISTRICTS WITH THAT OF OTHERS

The soil types in Konkan are: (1) Red soils, (2) Black soils, (3) Lateritic soils, (4) Coastal alluvial soils, common in coastal areas. We shall consider first those in Thane district.

Soils in Thane district can broadly be classified into two major types, i.e., (1) Coastal saline and alluvial, (2) Red and grey soils. The latter occupy major part of the district and are grouped in three categories as, (a) coarse shallow on slopes and clayey loam in valleys, (b) medium black soils in plains and deep black soils in valleys and low lands, (c) narrow strips of reddish-brown soils on hill slopes derived from traps.

The vegetation in Thane is of dry and moist deciduous types, the latter mainly in valleys. At places along higher slopes of ghats, it tends to form semi-evergreen tracts of forest with a meagre representation of evergreen species. The forests in South Ratnagiri district and in Goa are more or less the same and show similarity except that the vegetation is evergreen in parts and is denser in Goa and North Kanava due to continuous humidity throughout the year. Thane district is drier than Ratnagiri. The following plants occur in Thane district in different forests.

(1) Coastal tidal forests:

They are mostly composed of small trees of Rhizophora mucronata, Sonneratia caseolaris, S. apetala, Avicennia marina var. acutissima, A. officinalis, Bruguiera gymnorhiza, Ceriops tagal, Aegiceras corniculata Acanthus ilicifolius.

(2) Dry deciduous forests:

These occur on plains and upper slopes of hills composed of trees and shrubs of Acacia chundra, Careya arborea, Xerompius spinosa, Ixora coccinia, Syzygium caryophyllatum and grasses Digitaria ciliaris, Heteropogon contortus, Apluda mutica.

(3) Moist deciduous forest vegetation:

This consists of trees Anogeissus latifolia, Tectona grandis, Terminalia bellirica, T. crenulata, Lagerstroemia parviflora, Mitragyna parvifolia, Ficus religiosa.

Shrubs are Helicteres isora, Microcoas paniculata, Carissa congesta, Melastoma malabaricum, Moghana strobilifera. Herbs consist of Costus speciosos. Sida rhombifolia, Triumfetta rhomboidea. Urena lobata and climbers Gnetumula, Calycopteris floribunda, Diploclisia glaucescens.

(4) Semi-evergreen type of vegetation:

This consists of Mallotus philippensis, Memecylon umbellatum, Symplocos racemosus, Syzygium cumini, Actinodaphne angustifolia, Olea dioica.

Shrubs here are Callicarpa tomentosa, Nilgirianthus reticulatum, Jasminum malabaricum, Murraya paniculata, Elaeagnus conferta, Capparis rotundifolia.

(5) Herbs found are Eranthemum roscum, Lobelia nicotianaefolia, Carex filicina, Senecio dalzellii, Nogra simplicifolia, Oplismenus burmanni

All these are comparable with the vegetation in South Ratnagiri area.

- (1) Littoral zone. This has coastal mangrove vegetation in saline soils. This is mere or less the same as in Thane and Greater Bombay districts. It is composed of Rhizophora mucronata, R. conjugata, Sonneratia caseolaris, S. apetala, Bruguiera gymnorhiza, B. cylindrica, Kandelia candel, Ceriops tagal, Avicennia marina var acutissima, A. officinalis, Aegiceras corniculata, Lumnitzera racemosa, Excoecaria agallocha, Acanthus ilicifolius. The creek vegetation is composed of Thespesia populnea, Cerbera manghas, Erythrina orientalis, Canavalea rosea. Derris trifoliata, Clerodendrum inerme.
- (2) The Deciduous forest is composed of small trees and shrubs like Acacia chundra, Careya arborea, Leca macrophylla, Microcos paniculata, Zizyphus oenoplia, Carissa congesta, Holarrhena antidysenterica, Lagerstroemia purviflora, Lannaca coromandelica, Flacourtia indica, Syzygium caryophyllatum. Tectona grandis. Herbs are Sida rhomboides, Crotolaria linifolia, C. lutescens, Clerodendrum serratum, Costus speciosus, Manisuris acuminata, M. goaensis, Ischaemum santapauii, Climbers are Dioscorea bulbifera, Cocculus hirsutus. Tinospora sinensis. Ampelocisus latifolia.

The main feature of this vegetation is the deciduous nature of trees. All however do not shed leaves at one and the same time as rightly

pointed out by Santapau (1960) in his Flora of Khandala. Some plants shed leaves at the beginning of winter and form new foliage in spring. The vernal habit of these is clear e. g. Tectona grandis, Xylia xylocarpa Terminalia chebula, T. crenulata, Careya arborea, Xeromphis spinosa. Some shed leaves in the midst of rainy season e. g. Lagerstroemia, Alstonia, Holarrhena, Wrightia; but they also have the habit of shedding leaves, a characteristic of deciduous plant community.

(3) Moist deciduous Forest Vegetation: This is found along ghat slopes: The composition of this is in 3 layers: Tectona grandis, Terminalia crenulata, Syzygium cumini are the dominant tree species. Other Sub-dominant species are Sterculia guttata, Prunus zeylanıca, Bauhinia racemosa, Atalantia racemosa, Syzygium cumini, Ficus religiosa, tetrameles nudiflora, Nothopodytes foetida.

Shrubs are Helicteris isora, Microcas paniculata, Meyna laxiflora, Carissa congesta, Calamus pseudotenuis, Leea indica, Allophylus cobbe, Maesa indica.

Herbs are B'epharis asperrima, Impatiens pulcherrima, Gynura cusimbus, Elephantopus scaber, Apluda mutica, Oplismenus burmanni, Spodiopogon rhizophorus.

(4) Semi-evergreen forests: These occur along the middle slopes, in valleys on ghat tops and in Dev Rai. They are composed of trees Cryptocarya wightiana, Litsea stocksii, Dysoxylum binectariferum, Holigarna grahani, Dimocarpus longum, Cassine paniculata, Beischmiedia dalzellii, Syzygium hemisphericum, Vitex altissima.

Shrubs-Alcophila excelsa, Meiogyne pannosa, Dichopetalum gelonioides, Mallotus stenanthus, Ixora nigricans, Evonymus indicus Blachia denudata.

Herbs are Gymnostachyum glabrum, Lepidagathis fasciculuta, Epithema carmosum, Arthraxon gubatus.

Lianas-Salacia macrosperma, Uvaria narum, Embelia sp. Narvelia zeylanica, Dioscorea belophylla.

VEGETATION OF GOA

Soils in Goa are mainly of three types. (1) Laterite of high and low level type formed by natural metamorphosis and degeneration of undulating rocks along ghats, (2) Red gravelly soils derived from micaceous granite gneiss, covering the undulating plateaus mixed with medium black soils adjoining river banks, and (3) Alluvial soils including coastal alluvium along the coastal belt and in low lying situations.

1. The coastal vegetation in Goa is composed of Rhizophora mucronata, R. congugata, Sonneratia caseolaris, Avicennia marina vat. acutissima, Excoccaria agallocha, Kandelia candel.

The vegetation in creeks is composed of Thespesia populnea, Pongamia innata, Cerbera manghas, Calophyllum inophylum, Derris trifoliata, Caesalpinia cristata and Wedelia biflora.

(2) The deciduous type occurs in plains and on plateaus. It is made up of Carissa congesta, Holarrhena antidysenterica, Lantana camara var. aculeata, Vitex negundo, Grewia abutilifolia, Breynia retusa, Zizyphus

oenoplia, Ixora coccinea, Acacia chundra, Terminalia crenulata. On waste lands Scoparia dulcis, Leonotis nepetaefolia, Borreria pusilla, Phyllanthus asperulatus and species of Corchorus, Sida, Lecuas, Justicia grow profusely.

Climbers seen are Cocculus hirsutus, Cissampelos pareira, Ampelocissus latifolia, Cissus adnata, Tinospora sinensis, Dioscorea bulbifera. Cryratia trifolia.

In valleys there are pockets containing evergreen species.

(3) Moist deciduous forests. The important components of these deciduous forests are Terminalia crenulata, Tibellerica Anogeissus latifolia, Xylia xylocarpa, Dalbergia latifolia, Dillenia pentagyna, Careya arborea mixed with Adina cordifolia, Mitragyna parvifolia, Heterophragma quadriloculare and bamboos Dendrocalamus strictus and Bambusa arundinacea.

The top canopy is of arboreal members Lagerstroemia microcarpa, Terminalia crenulata, Albizzia odoratissima, Xylia xylocarpa, Schleichera oleosa, Alstonia scholaris, Xeromphis spinosa, Macaranga peltata and Strychnos nux-vomica. The moderately tall trees are of Canthium dicoccum, Xantolis tomentosa, Flacourtia montana.

The shrubby layer is made up of Callicarpa tomentosa, Ventilago maderaspatana, Zizyphus xylopyra, Leea latifolia, L. indica, Moghania strobilifera, Clerodendrum serratum, C. viscosum.

The ground flora comes up in forest clearings and exposed situations. It consists of Geissaspis cristata, Crotalaria linifolia, Crotalaria nana, Desmodium gangeticum, Alysicarpus rugosus, Justicia procumbens, Themeda trementa, Heteropogon contortus.

(4) Semi-evergreen forests are seen only in patches along the upper elevations of the ghats mostly above 500 m and bordering regions contiguous with the forests of Sindhudurg and North Canara down south. In this belt moist deciduous forests gradually change to semi-evergreen formation into isolated patches of typical evergreen species. They are seen scattered in the sheltered ravines and valleys. The tree canopy is composed of Michelia champaca (introduced), Myristica malabarica, Cryptocarya wightiana, Actinodaphne angustifolia, Lagerstroemia microcarpa, Holigarna grahami, Sapindus laurifolius.

Next in order come the trees of Alseodaphne semicarpifolia, Glochidion hohenackeri, Ixora nigricans, Blachia javanica, Linociera malabarica, Olea dioica, Macaranga peltata, Hopea wightiana, Clausena dentata. On the forest outskirts Ligustrum perrottetii, Meyna laxiflora Gomphandra axillaris, Wendlandia thyrsoidea, Glochidion velutinum Ficus exasperata, Celtis cinnamomea, Blachia denudana are present.

The third layer is composed of shrubs of Chassalia ophioxyloides, Psychotria dalzellii, Maesa indica, Maytenus rothiana, Paramignya monophylla, Glycosmis mauritiana, Leea indica and the scandent shrubs Layanga sarmentosa, Ancistrocladus, heyneanus, Sarcostigma kleinii, Connarus wightii, Strychnos colubrina, Salacia oblonga. In open disturbed forest areas Dillenia pentagyna, Careya arborea, Xeromphis spinosa are common together with climbers such as Argyreia involucrata, Jasminum malabaricum, Ichnocarpus frutescens, Smilax zeylanica, Mussaenda glabrata, Rubia cordifolia.

(5) The Evergreen forest: The forests here never reach climax as they do in North Kanara in Karnatak. Their density is much less, often quite patchy due to biotic interference. The lofty trees belong to Calophyllum elatum, C. apatalum, Garcinia cambogia, Canarium strictum, Chrysophyllum roxburghii, Palaquium ellipticum, Diospyros ebenum and Knema attenuata. Medium sized trees are of Litsea wightiana, L. coriacea, Aporosa lindleyana, Carallia brachiata, Euodia lunu-ankenda (near streams). Hydnocarpus laurifolia and Syzygium cumini are frequent. The forests abound in lianas such as Butea parviflora, Entada pursaetha, Schefflera venulosa, Chonemorpha fragrans, Gnetumula, Derris bekeri and Combretum latifolium.

The undergrowth is composed of such shrubs as Ixora coccinea Dracaena terniflora, Rauvolfia serpentina, Thelepaepale ixiocephala Mackenzia integrifolia.

The herbaceous vegetation in these forests consists of Geophila reniformis, Adenostemma lavenia, Costus speciosus, Curcuma decipiens, Ageratum coryzoides, Spilanthes paniculata, Habenaria marginata, H. heyneana, Geodorum densiflorum, Platanthera susannae and ferns Christella dentata, Pterisquadriaurita and Angiopteris erecta.

VEGETATION OF NORTH KANARA DISTRICT

The district has two types of soils viz. black and red. Black soils support evergreen or deciduous types of vegetation depending on soil types. Red soils support evergreen and moist deciduous types of vegetation. Hard shallow soils support only scrub. Rainfall ranges up to 5000 mm per annum. The climate is typically monsoonic.

Vegetation comprises four types as follows: (1) Tidal vegetation, (2) Scrub vegetation, (3) Moist deciduous forest vegetation, and (4) evergreen vegetation.

(1) Coastal or tidal vegetation is made up of Rhizophora mucronata, R. conjugata, Bruguiera gymnorrhiza, B., cylindrica, Kandelia candel, Sonneratia caseolaris, S. apetala, Ceriops tagal, Avicennia marina var. acutissima, Heritiera littoralis, Excoecaria agalloca.

The creek vegetation consists of Aglaia talbotii, Pongamia pinnata Derris trifoliata, Vitex negundo.

- (2) Scrub vegetation is composed of Carissa congesta, Maytenus rothiana, Ixora parviflora, Flacourtia indica, Bridelia stipularis, Zizyphus oenoplia, Lagerstroemia parviflora, Careya arborea in black soil. In lateritic soil scrub forest is found, made up of Gardenia lucida, Ixora coccinea, Glochidion hohenackeri, Carissa congesta, Flacourtia montana, Osyris arborea, Canthium dicoccum, Terminalia chebula, Santalum album (occasional). Common climbers are Dalbergia sympathetica, Celastrus paniculatus, Jasminum malabaricum, Zizyphus rugosa etc.
- (3) Moist deciduous type of vegetation—This usually does not show any stratification. They have open canopy. Trees may be evergreen or deciduous attaining a height of 23 metres or so. Their composition here is as follows:—

Trees: Grewia tiliaefolia, Adina cordifolia, Phyllanthus emblica, Madhuca latifolia, Dillenia pentagyna, Tectona grandis and Xylia Xylocarpa mixed with bamboos Dendrocalamus strictus and Bambusa arundinacea.

The deciduous species occur mixed. They are Terminalia tomentosa, Tectona grandis, Buchanania lanzan, Anogeissus latifolia, Lagerstroemia microcarpa, Grewia tiliaefolia, Diospyros melanoxylon, Dalbergia latifolia. Other species are Zizyphus rugosa, Z. oenoplia, Meyna laxiflora, Xeromphis spinosa, Helicteris isora, Acacia rugata, Dioscorea bulbifera.

(4) Evergreen forests: These are found in the central uplands of the district. The forests exhibit characteristic stratification, the forest storey exceeding 50—55 m. Some of the top storey trees are Artocarpus hirsutus, A. gomezianus, Alseodaphne semecarpifolia, Cinnamomum verum, Diospyros microphylla, Elaeocarpus tuberculatus.

It will thus be seen that the vegetation of five districts of Konkan is similar in point of types, but it gradually becomes sparse northwards; in arid areas it becomes almost scrubby in some places. It has small pockets of evergreen or semi-evergreen vegetation either in valleys rich in debris and in soil at high altitude. But in the latter case it looks as if the evergreen species are not only dwindling but even dying out. That is because of the high rainfall and complete washing and leaching of soils. Leaching of soils and their erosion are two factors which do not allow the climatic climax vegetation to come up in Konkan districts. Erosion is more where the soils are derived from sandy loam of metamorphic origin.

Flora in Sindhudurg is more similar to that of Goa and North Kanara. But is poor as compared to that in Kanara or Goa.

15. Main features of the flora of Konkan

- (1) Flora of Konkan comprises about 571 species to which about 20 new species have been added during last 25 years. The number of genera and family is approximately 602 and 142, respectively.
- (2) Because of humidity throughout the year, the plants in Konkan look always lush green as in Kerala.
- (3) The climate is very suitable for the horticultural crops, such as mango, jute, spices, Amsul (Garcinia indica), various palms including oil palm in northern part.
- (4) Essential oil yielding species thrive well in South Konkan. However, the lateritic soils are not much fertile for foodgrain crops. Rice, millets like Ragi and Rala grow, but it is more suitable for tuber crops and leafy vegetables.
- (5) In the sandy soils there is a probability for growing bamboo and orchards of fruit trees. Some species grow well around Dahanu, Dapoli, Ratnagiri etc.
- (6) Mangoes grow well in Ratnagiri, and are a great source of income by exporting them to Bombay and abroad. Medicinal plants grow well in Sawantwadi, Aronda and Malwan.
- (7) Where the soils are alluvial or black, they produce good crop of sugarcane.
- (8) Mangroves form a continuous strip along the littoral zone. In the sublittoral zone, there are forests of strand plants.

- (9) The forests grow teak fairly well especially in Jawhar and Ratnagiri ranges, but it is not so good as that in Dangs (Gujarat).
- (10) The mountain tops are barren, due to soil erosion by heavy rains, at places not even good grass grows. This has direct effect on the milch cattle in Konkan.
- (11) There is high possibility of growing marine algae along the rocky coast especially near Malwan and Vengurla which are known to have trenches full of food material for the fishes and marine fauna.
- (12) Flora of all the districts of Konkan is more or less similar qualitatively, but density and dominance of species differ.
- (13) In the fort of Sindhudurg, there is a continuity of plants similar to those on the main land, although enclosed within the fort walls.
- (14) At Vajreshwari, Mahad, Sangameshwar and a few other places there are hot water springs which are believed to have medicinal properties. They need full investigation.
- (15) Opposite the Konkan coast there are small islands which do not contain insular flora (See the list of islands and their flora).
- (16) Sea level of Ratnagiri coast seems to have been much higher in the past than what it is at present. This is indicated by leafy beds at a higher level 7 to 9 metres at Ratnagiri, Pavas and other places.
- (17) Main floral elements in the flora of north Konkan are the same as are found in the flora of Desh side and South Gujarat. But the elements form the evergreen and semi-evergreen forests of Malabar, Karnatak and Goa are found, especially in the or Sindhudurg district. They also contain some elements from the flora of North Abyssinea, East Africa and Madagascar. A few elements are also of Malayan origin. However, the Malayan elements are only a few and are lingering, but in the evergreen forests of Mysore, North Kanara, Malabar and Nilgiris they are in greater abundance and continue further south. No plants from desert regions occur in Konkan. This and other aspects of the flora of Konkan need careful study and analysis.

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CHAPTER VIII—FLORA OF DESH

Region to the east of Sahyadris, lying between rivers Krishna, Bhima, Sina and Godavari is recognised as Desh, comprising seven districts viz., Kolhapur, Sangli, Satara, Pune, Nasik, Ahmednagar and Sholapur. Like Konkan, Desh districts are influenced by the Sahyadri. The Desh extends eastwards 563.2 km. or more. The influence of Sahyadri on plants, animals and life of people, is evident. The rainfall in Konkan is about 2032 mm.—2540 mm. per year. On the high peaks of Sahyadri it is 3850 mm.—6350 mm., but as one goes eastwards the rainfall becomes rapidly less, and some parts are under the rain shadow. On an average it is about 608 mm.—635 mm. on Desh side, except in Ahmednagar, Sholapur and eastern parts of Pune district such as Shirur or Parner in Ahmednagar where it is less. Rain is regular and assured in Konkan, but it is erratic and not uniform on Desh. It is very uncertain in parts of Madhya Maharashtra, and has given rise to famine zone of Sholapur, eastern part of Pune district and Ahmednagar.

Climate of Konkan is humid and moderate, equable and breezy. But the climate of Desh is hot and dry, as the humidity is poor. There is about 60 per cent humidity or more for four months in a year. The ratio of humid period to dry period, 4: 8, greatly affects the plant life and vegetation which looks dry. Plants in Konkan look always green and fresh due to high humidity 60—70 per cent throughout the year. The semi arid and dry climate of Madhya Maharashtra has given rise to dry deciduous forests all over the Desh in Maharashtra. For greater part of Desh, the trap hills look dark and barren, but in rainy season they suddenly become green due to sudden emergence of ephemeral plants sprouting all over.

Terrain of Madhya Maharashtra is terraced and uneven having variable altitude. The general slope and drainage are towards south-east. The country is crossed over by many small and large streams and rivers Krishna, Bhima and Godavari and their tributaries. They practically cut Desh into compartments by their valleys and basins.

Soils of both Desh and Konkan are derived from Deccan traps, but they are more matured and are heavy on Desh side. Konkan soils are leached every year by heavy rainfall. They are loamy and lateritic with a large proportion of iron oxides. On the Desh side they are slightly alkaline, or black cotton soils—brown or regur soils. In Konkan they are mostly gravelly or lateritic and shallow. Some look yellowish due to mixture of coastal littoral concrete. On the Desh side they are deep black or reddish. In river valleys they are alluvial.

In Kolhapur, Sangli, Satara, Pune, Nasik and western part of Ahmednagar, Sahyadri ranges run directly on their western fringe, but in other districts only their lateral extensions or spurs run, e.g. Balaghat, Mahadev, Garbhagiri and Satamala ranges. Parts close to direct ranges of Sahyadri are just like Konkan. They are called 'Dang', 'Maval' or 'Pangan'. Their soils are lateritic or gravelly. But since the country on Desh side is terraced according to altitude, the soils are better preserved and matured and enable the people to take both Kharif as well as Rabi crops—cereals, groundnut, pulses, sugarcane, cotton, chillis etc. Rabi crops give better yields in river valleys. The soil elsewhere is shallow, sometimes hardly 3", but the black cotton soils in river basins are heavy and have proved excellent for cotton, wheat, sugarcane on account of the

irrigation facilities and highly suitable seasonal climate. Given sufficient fertilizers and water, sugarcane in these districts yields higher recovery of sugar.

The average height of the Sahyadri is 1200 m. The highest peaks are in the Desh region—Kalsubai (altitude 1646 m.), Harishchandragad (1424 m), Mahabaleshwar (1438 m). The variation in local topography and soils gives rise to varied vegetation. But the overall picture of vegetation of this region is dry deciduous forest, mostly of Tectona grandis due to semi-arid conditions. There are no mangroves on the Desh side, nor continuous stretches of evergreen forests as in Malabar. Only some pockets of evergreen or semi-evergreen vegetation occur here in regions close to Sahyadris. When they degenerate, they produce moist deciduous forest in high rainfall regions, or change into dry deciduous forests in low rainfall areas. But when they also degenerate they form a thorn savannah or a scrub. If the soil be poor, there are only open grasslands. In many dry sandy or gravelly areas succulents and xerophytes occur. Near Daund Acacia arabica grows on river banks and forms a thick Acacia tract, which is a post-climax vegetation.

With these preliminary remarks, we shall now consider the flora and the factors affecting it in each district separately.

1. FLORA OF KOLHAPUR DISTRICT

Stray references to the flora of Kolhapur are available in Literature. Prof. S. A. Parandekar had given a list of it. Diwan (1978), Mahajan and Vaidya (1969), A. R. Kulkarni and Mudgal (1971), Kulkarni and Desai (1972), Sharma and B. G. Kulkarni (1980) have worked on it. But there is no comprehensive account of the rich flora of Kolhapur. Members of the Botanical Survey such as Singh, Malhotra and Mudaliar (1972) have published account of some plants in the Flora of Kolhapur district. They enumerated 301 species inclusive of pteridophytes. Recently, however, A. R. Kulkarni and A. N. Thite (1979), have published additions to the flora of Kolhapur district (Bom. Nat. Hist. Soc. 74, 592—609). This is a fairly representative account of the Kolhapur district flora, and as such the plants they mentioned are given below. They have described 450 wild species, belonging to 334 genera and 114 families. It is clear that the flora of Kolhapur is pretty rich and deserves to be fully explored further.

1.1. Plants of Kolhapur District.—(Mainly Kolhapur and Panhala Area.):

Menispermaceae:

Tinospora cordifolia (Willd) Miers.—A common climber, Kolhapur, Panhala.

Cocculus hirsutus (Linn.) Diels.—In open grasslands, Kolhapur, Panhala.

Cissampelos pareira Linn,—A climber in forests or at forest edges, Katyayani, Panhala, Gaganbavada.

Nymphaeaceae:

Nymphaea stellata Willd.—Red and white flowered forms occur.
Rankala and Shiroli tank, Kolhapur.

Nelumbo nucifera Gaertn.--Laxmi Talao, Kolhapur.

Papaveraceae:

Argemone mexicana Linn.—A weed in waste land, Kolhapur, Panhala.

Brassicaceae:

Cardamine trichocarpa Hochst ex. Rich.—In moist places on walls of Panhala fort.

Cironopus didymus (Linn). Sm.—A rare garden weed.

Capparaceae:

Clemo simplicifolia Hook f. and Thoms.—Common in open grasslands, Kolhapur, Panhala.

C. viscosa Linn.—In waste lands, Kolhapur.

C. chelidonii Linn.—In puddles and along streams in mid-monsoon season, Kolhapur, Katyayani.

Cratevareligiosa Forst.—A tree near Gokhale College hostel, Kolhapur. Cadaba indica Lam.—Along the bunds of fields, Rankala, Kolhapur.

Flacourtiaceae:

Flacourtia indica (Burm. f.) Merrill.—In open forests, Katyayani, Panhala.

Polygalaceae:

Polygala chinensis Linn.—Pasture lands, Kolhapur, Panhala. Land opposite Rankala, Kolhapur.

Portulacaceae:

Portulaca oleracea Linn.—Common along road sides, Kolhapur, Panhala.

P. grandiflora Linn.—An escape along Rankala, Kolhapur.

Elatinaceae:

Bergia ammannioides Heyne ex Roth.—Common hygrophyte near tanks at Kolhapur.

Malvaceae:

Abutilon indicum (Linn.) Sweet.—Grasslands and waste lands, Kolhapur, Panhala.

Malachra capitata Linn.—An uncommon weed. Sida spinosa Linn.—In grasslands, Kolhapur.

Bombacaceae:

Bombax ceiba Linn.—In open forests, Panhala, Kolhapur.

Sterculiaceae:

Helicteres isora Linn.—Forest margins and clearings, Panhala, Gaganbayada.

Eriolaena quiquelocularis Wight.

Flacourtia indica (Burm.) Merrill.—In open forests, Katyayani, Panhala.

Caryophylaceae:

Saponaria vacaria Linn.—Escape from cultivation, University campus. Polycarpon prostratum (Fork) Aschers and Schw.—Forms carpet in wet places at Katyayani and Radhanagari forests.

Tiliaceae:

Corchorus olitorius Linn.—In waste land, Kolhapur.

Triumfetta bartramia Linn.—Forest edges and in open places, Panhala.

Malpighiaceae:

Hiptage benghalansis (Linn.) Kurz.—A woody climber with beautiful flowers at Katyayani, Panhala.

Zygophyllaceae:

Tribulus terrestris Linn.—Common in dry places, Kolhapur.

Oxaliadaceae:

Oxalis corniculata Linn.—Weed in gardens, Kolhapur, Panhala. Biophytum sensitivum DC.—In moist places, Kolhapur.

Balsaminaceae:

Impatiens balsamina Linn.—Conspicuous in middle monsoon, Kolhapur, Katyayani, Panhala.

I. inconspicua Benth.—Common in monsoon in pastures, Radhanagari, Gaganbavada,

I. pulcherrima Dalz.—In shades plant is worthy of cultivation, Panhala, Ambaghat.

Rutaceae:

Atalantia racemosa Wight and Arn.—Panhala forests, Ambaghat.

Aegle marmelos (Linn.) Correas.—Planted in temples, Kolhapur,

Katyayani.

Glycosmis pentaphylla (Retz) Correa.—Forests of Panhala, Gagan-bavada, Ambaghat.

Murraya koenigii (Linn.) Spreng.—Common in forest shades, Panhala, Ambaghat.

Meliaceae:

Cipadeasa bacifera (Roth.) Mig.—Forest edges near Gaganbavada. Heynea triguga Roxb.—Forests near Gaganbavada, Ambaghat.

Simarubiaceae:

Balanites roxburghii Planch.—Along Miraj road; drier parts of Kolhapur district.

Opiliaceae:

Cansjera rheedii Gmel.—Open forests Katyayani, Ambaghat.
Nothopodytes foetida (Wight) Sleumer.—Common in open forests,
Panhala, Ambaghat.

Sarcostigma kleinii Wight and Arn.—A climber in forests between Amba and Vishalgad.

Celastraceae:

Celastrus paniculata Willd. —A common straggler along forest margins and open areas Katyayani, Panhala.

Gymnosporia montana Benth.—Katyayani, Panhala.

Hippocrateaceae:

Pristimera grahamii (Wight) A. C. Smith,—Along fort slopes near Baji Prabhu Point, Panhala.

Rhamnaceae:

Zizyphus mauritiana Lamk.—Several trees are seen on the outskirts of Kolhapur, Katyayani and Panhala but not in actual forest areas.

 rugosa Lamk.—A common climber at Katyayani, Panhala, Gaganbayada and Amabghat.

Z. oenoplia Mull.—In grasslands of Kolhapur.

Vitaceae:

Cayratia elongata (Roxb.) Suesseng.—Very common climber Panhala and Gaganbavada.

Cissus pallida Planch,—Rocky areas at the base of Panhala fort.

Leea macrophylda Roxb. ex Horneum.—Quite common in cleared forests. Katyayani.

L. indica (Burm). Merrill.—Very common shrub in forest margins, Panhala Gaganbavada, Radhanagari, Ambaghat.

Sapindaceae:

Allophyllus serratus (Roxb) Radlk.—Scandent shrub in forest shade, Panhala, Gaganbavada.

Cardiospermum helicacabum Linn,—In grassland, Kolhapur, Katyayani, Panhala.

Schleichera oleosa (Laur.) Oken.—Forests at Katyayani; not common. Sapindus laurifolius Vahl..—Near human dwellings.

Anacardiaceae:

Mangifera indica Linn.—Abundant in Panhala and Amba.

Lannea coromandelica (Houtt.) Merrill.—A small tree, Katyayani, Panhala fort.

Semecarpus anacardium Linn.—A few trees near Katyayani temple.

Holigarna grahami (Wight) Hook. f.-In Ambaghat forests.

Nothopegia colebrookiana Blume.-Forests of Ambaghat and Radhanagari.

Fabaceae:

Coniogyna hirta (Willd.) Ali.—Very common in Pasture lands.

Crotalaria filipes Benth. var. trichocarpa Benth (Ex Baker) Cooke Pasture lands, Kolhapur, Panhala.

C. juncea Linn.—A escape at Kolhapur.

C. lutescens Dalz .- In grasslands, Kolhapur, Panhala.

C. orixensis Willd.--University campus, Kolhapur.

C. prostrata Roxb.—Amongst grasses, Panhala. C. spectabilis Roth.—Grasslands, Katyayani.

C. vestita Baker.—Along forest margins and grasslands, Panhala.

Indigoferia cordifolia Heyne ex Roth.—In grasslands.

I. dalzellii Cooke.—In moist rocky places, Panhala. I. linnaei Ali.—In grasslands, Kolhapur.

I. hendecaphylla Linn.—Moist open places and grasslands at Rankala, Panhala.

I. linifolia Retz.—Pasture lands, Kolhapur.

I. pulchella Roxb.—A shrub in grasslands, Panhala.

I. tinctoria Linn.—In waste lands, Kolhapur, Panhala. I. trita Linn.—Kolhapur, Katyayani, Panhala.

I. taphrosia coccinea Wall.—A shrub in open land, Radhanagari.

I. pumila Pers.—Grasslands of Kolhapur (rare).

I. purpurea Pers.—A shrub of grasslands, Kolhapur, Panhala.

I. strigosa (Dalz). Santapau. - In grassland, Kolhapur. Geissaspis cristata Wight and Arn.—Grasslands, Panhala.

Zornia diphylla Pers.—Common in grasslands.

Smithia bigemina Dalz .- Very common, attractive in grasses in monsoon, Ambaghat, Panhala.

S. blanda var. racemosa Baker. - Kolhapur, Panhala.

S. conferta Sm.—University campus, Kolhapur, Panhala.

S. setulosa Dalz.—Grassy places, Kolhapur.

Aeschynomene indica Linn.-Common monsoon herb in moist places, Kolhapur.

A. aspera Linn.—Vadanige lake near Kolhapur.

All species of Alysicarpus noted below are found in grasslands.

Alysicarpus belgaumensis Wight.—Radhanagari.

A. bupleurifolius DC.—Kolhapur,

- A. pubescens Law.—Kolhapur.
- A. rugosus DC.—Kolhapur.
- A. rugosus var. heyneanus Baker.—Kolhapur.
- A. tetragonolobus Edgew.—Kolhapur, Panhala.
- A. vaginalis DC.—Kolhapur, Panhala.
- Desmodium diffusum DC.—Amongst grass, Kolhapur.
- D. gangeticum (Linn.) DC.—A shrub in open places and forest clearings, Panhala, Gaganbayada, Radhanagari.
- D. latifolium DC.—An undershrub with spreading branches, Panhala.
- D. laxiflorum DC.—Undershrub, Kolhapur, Panhala.
- D. polycarpum DC.--Often in shades of forest trees, Gaganbavada, Radhanagari.
- D. rotundifolium Baker.—Spreading herb in grasses Katyayani, Panhala.
- D. triflorum (Linn.) DC.—Very common in rocky areas, Panhala, Radhanagari.
- D. triquetrum DC.—Panhala.
- Abrus precatorius Linn.—A climber in forests or along forest margins, Gaganbavada, Radhanagari.
- Teramnus labialis Spreng.—A twiner along forest edges.
- Mucuna prurita Hook.—Forest edges, Gaganbavada.
- Erythina variegata Linn. var orientalis (Linn.) Merr.—Some trees here and there.
- Butea monosperma (Lamb.) Taub.—Dry areas around Kolhapur, Katyayani.
- Pueraria lobata (Willd.) Ohwi.--Amongst grasses Kolhapur.
- Clitoria ternatea Linn.—In hedges or often cultivated.
- Atylosia scarabaeoides Benth.—Forests of Radhanagari.
- Moghnnia strobilifera (Linn.) St. Hil ex Jacks.—At the edges of forests, Radhanagari, Panhala.
- Dalbergia latifolia Roxb.—A few trees at the base of Panhala fort infected with Viscum angulatum.
- D. sympathetica Nimmo ex Grah.—A hooked climber, common in forests of Panhala, Radhanagari and Ambaghat.
- Derris indica Lamk. Bennet (Pongamia pinnata (Linn.). Pieerre).—Common around Kolhapur, Panhala.

Caesalpinaceae:

- Caesalpinia sepiaria Roxb.—Along bunds of sugarcane fields. Panhala fort near Jebak bag.
- Wagatea spicata Dalz.—In forests of Panhala, Ambaghat.
- Cassia fistula Linn.—Panhala, Radhanagari.
- C. sophora Linn.—Katyayani, near Phule Wadi, Kolhapur.
- C. tora Linn.—In waste lands, Kolhapur.
- C. absus Linn.—Among grass, Katyayani, Kolhapur.
- C. pumila Lamk.—In pasture lands, Kolhapur.

Acacia concinna DC.—Common at Panhala.

Mimosaceae:

- Entada scandens Benth. (=E. pursaetha).—In dense forests of Radhanagari and Ambaghat.
- Dichrostachys cinea Wight and Arn. -- In rocky open areas, Kolhapur.
- Mimosa pudica Linn.—A weed.

 M. hamata Willd.—Rocky open areas of University Campus, Kolhapur.

Crassulaceae:

Bryophyllum pinnatum (Lam) Oken.—In moist places, Panhala, Ambaghat.

Droseraceae:

Drosera burmanni Vahl.—Along margins of temporary ponds near Amba village.

D. indica Linn.—In most places among grasses near Panhala, Kolhapur.

Rhizophoraceae:

Carallia brachiata (Laur.). Merril.—In dense forests of Radhanagari and Ambaghat.

Combretaceae:

Terminalia chebula Retz.—Very common in Ambaghat, Panhala, Gaganbavada forests.

Terminalia bellerica (Gaertn.) Roxb.—Panhala.

T. crenulata Roth.—Panhala and Radhanagari.

Mvrtaceae:

Syzygium cumini (Linn.) Skeels.—Abundant in Panhala.

Loecythidaceae:

Careya arborea Roxb.—Common in Panhala, Radhanagari and Gaganbayada forests.

Melastomaceae:

Osbeckia truncata D. Don ex W. and A.—In grasslands and moist rice fields, Gaganbavada.

Lythraceae:

Rotala densifolora (Roth.) Koehnne.—In moist places along margins of ponds and puddles, Panhala.

Ammannia baccifera Linn.—In marshes, Kolhapur.

Woodfordia fruticosa (Linn.) Kurz.—In forest clearings near Radhanagari, Gaganbavada: Sometimes on old fort walls, Panhala.

Onagraceae:

Ludwigia perennis Linn.—In marshy places, Kolhapur.

Cucurbitaceae:

Trichosanthes bracteata (Lamk.) Voight.—A common climber at Panhala and Gaganbavada.

T. cucumerina Linn.—Rare twiner, Panhala.

Bryonopsis laciniosa Naud.—Often on hedges, Katyayani.

Melothria maderaspatna Cogniaux.—Very common in Kolhapur.

Begoniaceae:

Begonia crenata Dryand.—Pretty common in moist places at Panhala, Gaganbavada, Ambaghat, Radhanagari.

B. trichocarpa Dalz.—On forest trees at Gaganbavada.

Cactaceae:

Opuntia dillenii Haw. - A weed of dry localities.

Molluginaceae:

Glinus lotoides O. Kunze.—Growing on moist clayey soils.

Mollugo pentaphylla Linn.—Common in moist places of Kolhapur, Panhala.

M. pentaphylla var rupestris Cooke.—In moist rocky places around Panhala.

Aizoaceae:

Trianthema portulacastrum Linn.—Along road sides.

Apiaceae:

Contella asiatica (Linn.).-N. A.

Pimpinella adscendens Dalz.-In grasslands.

P. lateriflora Dalz and Gibs.—In forest clearings on way to Gaganbavada.

Peucedanum dhana Ham. In grasslands of Kolhapur.

Rubiaceae:

Anotis foetida (Dalz.) Benth and Hook.—Herb in rocky moist areas.

A. lancifolia (Dalz) Hook f.—Abundant and conspicuos monsoon herb in grasses, Jyotiba, Panhala.

A. montholoni Hook f.—In grasses, University campus, Kolhapur.

A. rheedei Benth and Hook f .-- Jyotiba, Panhala.

Borreria hispida (Linn.) Schum.—Rocky places, University campus, Kolhapur.

Canthium parviflorum Lamk.—Not common, near Rankala.

C. dicoccum (Gaertn.) Merrill.—Forest of Ambaghat.

Dentella repens (Linn.) Forsk.—Mat-forming hygrophyte. Lake, Rajaram tank, Kolhapur. Kaga

Hamiltonia suaveolens Roxb.—Amongst stone crevices of Sadoba tank, Panhala.

Hymenodictyon obovatum Wall.-Along slopes towards fort, Gaganbavada along Rajdindi road, Panhala, Vishalgad, Ambaghat.

Ixora arborea Roxb. ex. Sm.—Common small tree in forest, Panhala.

I. elongata Heyne.—Behind Katyayani temple, Katyayani. Meyna laxiflora Robyns .-- Rocky grasslands, Kolhapur.

Oldenlandia crystallina Roxb.—In moist rocky places, Panhala.

O. corymbosa Linn.-Pasture lands, Panhala.

O. herbacea (Linn.) Roxb. Panhala.

Pavetta indica Linn.—At edges of forests and along cleared areas. Panhala, Gaganbavada, Radhanagari.

Randia uliginosa DC.—Behind Katyayani temple. A few trees.

Rubia manjith Roxb. en Flem.—Panhala. Wendlandia thyrosoidea Steud.—Along forest edges, Panhala.

Xeromphis spinosa (Thunb.) Keay.—Very common on Panhala fort plateau.

Asteraceae:

Acanthospermum hispidum DC.—A weed.

Artemisia vulgaris Linn.—Along edges of Jabak Udyan, Panhala.

Bidens biternata (Lour.) Merr and Sheff.—A weed at Gopaltirth, Panhala, Kolhapur.

Blumea malcolmii Hook. f.—Densely hairy herb in open areas: post harvest weed in rice fields.

B. membrenacea DC.—In dry areas.

Caesulia axillaris Roxb.—Common in marshy places. Kolhapur.

Cyathocline purpurea (D. Don) O. Ktze.—Weed in rice fields.

Elephantopus scaber Linn.—Shady forest clearings Panhala, Ambaghat. Eclipta prostrata Linn.—Common in grasses along Kolhapur,

Echinops echinatus Roxb.—Dry rocky places, Kagal.

Flaveria contrayerba Pers.—Weed in waste places.

Gymura angulosa DC.--Edges and slopes of Ambaghat.

Gnaphallum indicum Linn-Moist and marshy places, Rajaram tank Kolhapur.

Lactuca juncinata DC.—A weed in cultivated fields.

Lagascea mollis Cav.—Quite common and gregarious in waste places. Kolhapur.

Parthenium hysterophorus Linn-A rapidly spreading dangerous weed. Kolhapur.

Pulicaria wightiana C. B. Clarke.—Amongst grasses, Kolhapur.

Senecio grahami Hook, f.—Often on old walls, Panhala,

Sphaeranthus africanus Linn,—Forest edges, Panhala.

Tridar procumbens Linn.—In rocky dry places along road sides, Kolhapur, Panhala.

obeliaceae:

Lobelia alsinoides Lamk.—In pasture lands, Panhala, Gaganbavada.

L. heyneana Roem. and Sch. —Pasture lands, Amba village.

L. nicotianaefolia Heyne.—In dense forests and forest edges, Panhala, Ambaghat,

Plumbaginaceae:

Plumbago zevlanica Linn.-In dry open areas, Kolhapur.

Primulaceae:

Anagallis arvensis Linn.—Along road side, Kolhapur.

A. pumila Swart.—Monsoon herb in pasture lands at the Panhala fort.

Myrsinaceae:

Maesa indica Wall .-- Along forest edges, Panhala (Rare), common at Radhanagari.

Embellia tjariam (E. ribes) Cottom A. DC.—Katyayani (Rare).

Sapotaceae:

Xantolis tomentosa (Roxb.) Raf.—Common in Panhala on way to Tin Darwaja from Sadoba darga.

Mimusops elengi Linn.—Very common on Panhala plateau.

Ebenaceae:

Diospyros montana Roxb.—Generally in association with Xantolis tomentosa, Panhala.

Oleaceae:

Jasminum malabaricum Wight.-Katyayani, Panhala, Gaganbayada. Ambaghat. Very common in all places.

सत्यमव जयत

Schrebera swietaeoides Roxb.—Noticeable near Gaganbavada village on way to fort.

Apocynaceae:

Carissa congesta Wight.—Gregariously growing at Panhala, Katyayani.

Rauvolifia conescens Linn.—A rare weed at Kolhapur.

Catharanthus pusillus (Murr.) G. Don.—A weed in gardens, Kolhapur.

Alstonia scholaris (Linn.) R. Br.—Near Amba village.

Holarrhena antidysenterica Wall.—Common at Katyayani, Panhala and Gaganbavada.

Tabernaementana heyneana Wall.-Along road sides between Amba village and rest house.

Vallaris solanecea (Roth.) Kuntze.—Pusati point along fort wall. Panhala.

Periplecaceae:

Hemidesmus indicus R. Br.—Common in forest clearings, Panhala. Gaganbavada.

Crypotolepis buchanani Roem and Schult.—Common Kolhapur, Katyayani, Panhala.

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Asclepiadaceae:

Asclepias curssavica Linn.—Kolhapur.

Calotropis gigantea R. Br.—In waste lands, Kolhapur, Panhala.

Ceropegia attenuta Hook.—In grasslands, Katyayani.

C. tuberosa Roxb.—In forests at Panhala.

C. huberi Ansari.—Along forest slopes of Ambaghat.

Dregea volubilis Benth ex. Hook.—Near Rajaram tank, Kolhapur, Ambarkhana border, Panhala.

Gymnema sylvestrais (Ret.) R. Br.—Panhala.

Hoya pendula Wight and Arn.—In forests of Ambaghat.

Leptadenia reticulata Wight and Arn.—Forest edges, Gaganbayada.

Pergularia daemia (Forsk.) Blatt and Mcc.-In hedges Kolhapur, Gaganbayada.

Tylophora dalzellii Hook f.—Common at Panhala.

Loganiaceae:

Strychnos colubriana Linn.—Forests near Gaganbavada.

Menyanthaceac:

Nymphoides indicum (Linn.) O. Kuntze.—Rankala tank, Kolhapur. Kagal lake.

N. cristatum (Roxb.) O. Kuntze.—Panhala, Kolhapur, lake at Kagal.

Gentianaceae:

Canscora diffusa R. Br.—In moist places along slopes, Katyayani, Gaganbavada, Ambaghat.

Centaurium roxburghii (G. Don) Druce.—In moist places on University campus, Kolhapur.

Exacum bicolor Roxb.—On way to Katyayani; along pasture lands.

E. lawii Clarke.—In pasture lands, Kolhapur, Panhala, Gaganbayada. E. petiolare Griseb.—In pasture lands, Kolhapur.

Ehretiaceae:

Cordia dichotoma Forsk, f.—Common at Panhala, Katyayani,

Boraginaceae:

Adelucaryum coelestinum (Lindl.) Branch.—Along slopes of Ambaghat. Coldenia procumbens Linn.—Rajaram tank, Kolhapur.

Cynoglossum meeboldii Branch.-Forest edges, Panhala, Radhanagari.

Heliotropium ovalifolium Forsk.—In grassy places, Kolhapur.

Trichodesma amplexicaule Roth.—A weed in fields and waste lands, Kolhapur.

Cuscutaceae:

Cuscuta reflexa Roxb.—Common, specially on hedges on Clerodendon. Duranta, Vitex.

Convolvulaceae:

Argyreia hookeri Clarke.—Common at Panhala, Ambaghat.

A. elliptica Choisy, Panhala.

Convolvulus arvensis Linn.—A weed.

Erycibe wightiana Graham.

Evolvulus alsinoides Linn.—In grasslands.

Inomoca aquatica Forsk .- Common in all tanks at Kolhapur, Vadanage,

1. cairica (Linn.) Sweet.—Extensively cultivated and run wild. A-127--35-B.

I. longiflora R. Br.—Along hedges with prominent subspinous tubercles; near Rankala, Kolhapur.

I. obscura Ker.—Gavad, Ambaghat.

Merremia hastata Hallier.—In dry rocky areas of Kolhapur.

Solanaceae:

Datura matel Linn.—Common weed.

Nicandra physaloides (Linn.) Gaertn.—Weed.

Physalis minima Linn.—Weed. Solanum nigrum Linn.—Weed.

S. surattense Burm. f.—In dry rocky areas along road sides.

S. indicum Linn.—Very common throughout Panhala, Katyayani.

S. tortum.—Along bunds of sugarcane fields.

S. seaforthianum Andr.—Escape from cultivation, Rankala, Kolhapur, Panhala.

Withania somniferum Linn.—Weed in waste places, Kolhapur.

Scrophulariaceae:

Artanema longifolia (Linn.) Merrill.—In grasslands of Gaganbavada, Radhanagari and Amba.

Bacopa monnieri (Linn.) Pennell.—Common in ditches, Kolhapur, Radhanagari.

Dopatorium junceum (Roxb.) Buch. Ham.—Marshy places, Kolhapur, Katyayani.

Kickxia ramosissima (Wall.) Janchen.—On fort walls and old buildings, Kolhapur, Panhala, Gaganbayada.

Limnophila sessiliflora Blume.—Common in many tanks around Kolhapur.

Lindernia anagallis (Burm.) Pennell.—A weed in rice fields, and marshy places.

L. ciliata (Colms.) Pennell.—A monsoon herb in moist places.

L. crustaceae (Linn.) J. Mueller.—Moist places, Panhala, Malkapur.

L. parviflora (Roxb.) Haines.—Herb in marshes, Kolhapur, Katyayani, Kadamwadi, Gaganbayada.

Mimulus strictus Benth.-Kolhapur, Katyayani, Gaganbavada.

Peplidium meritimum (Linn.) Wettst.—Marshes of Vadanage lake near Kolhapur.

Rhamphicarpa longiflora (Arn.) Benth.—Moist places pasture lands. Sopubia delphinifolia (Roxb.) G. Don.—Grasslands, Panhala.

Stemodia viocssa Roxb.—A hygrophyte, Kolhapur, Radhanagari. Striga densiflora Benth.—Weed in jowar and sugarcane fields, Kolhapur Tandulwadi, Gaganbayada.

S. euphrasicides (Vahl) Benth.—Grasslands, Kolhapur. S. gesneroides (Willd.) Vatke.—Panhala, Ambaghat.

S. sulphurea Dalz and Gibs.—Amongst grasses, Kolhapur,

Verbascum chinense Santapau.—Along road side Malkapur, Radhanagari, Kolhapur.

Orobanchaceae:

Aeginetia indica Linn.—A root parasite in dense forests, Gaganbayada, Ambaghat.

Christisonia calcarata Wight.—Parasite on roots of Carvia callosa on way to fort top, Gaganbayada.

Gesneriaceae:

Klugia notoniana (Wall,) A. DC.—Moist wall crevices, Panhala, Gaganbayada.

obliquum Blume var. parviflora Clarke.—On Rhynchoglossum forest slopes areas, Gaganbavada.

Bignoniaceae:

Heterophragma quadriloculare (Roxb.) K. Schum.—Common at Panhala and Katyayani.

Tecoma stans (Linn.) H. B. and K.—In dry places around Kolhapur, base of Panhala fort.

Pedaliaceae:

Sesamum laciniatum Klein ex Willd.—Common around Kolhapur and near Kagal in dry rocky soils in grasses.

Martyniaceae:

Martynia annua Linn.—In waste places.

Acanthaceae:

Adhatoda vasica Nees.-Panhala, Gaganbavada.

Andrographis paniculata (Burn f.) Wall ex. Nees.—Along forest edges Jyotiba, Panhala.

Asteracantha longifolia (Linn.) Nees.—Along sewage canals, Kolhapur. Asystasia dalzellina Santapau.—Near Tin Darwaja and Tabak Udyan, Panhala.

A. lawiana Dalz.—Behind Katyayani temple.

Barleria cristata Linn.—In hedges (cultivated).

B. gibsoni Dalz.-Grasslands, Katyayani.

B. prionitis Linn.—Common in hedges.

Blepharis asperrima Nees.—Under the shade of forest trees, Panhala, Ambaghat.

Carvia callosa (Wall.) Brcm.—Thickets along slopes to Gaganbavada. Eranthemum roseum R. Br.—In shade, Panhala, Gaganbavada.

Haplanthus verticillatus (Roxb.) Needs.—Along forest edges in shade, Panhala.

Lepidagathis cristata Willd.—Amongst grasses, Kolhapur, Kagal, Panhala.

Justicia betonica Linn. - Panhala.

Peristrophe bicalyculala (Retz.) Nees.--Panhala, Jyotiba.

Rostellularia crinita Nees.-Road sides, Kolhapur.

Rungia elegans Dalz. and Gibs.—Along road sides, Kolhapur.

R. pectinata (Linn.) Nees.--Amongst grasses, Panhala.

Verpenaceae:

Calicarpa tomentosum (Linu.) Murray.—Forest, Panhala, Ambaghat. Clerodendrum fragrans (Vent.) R. Br.—Mostly cultivated but grows as an escape in Panhala.

C. viscosum Vent.—Very common in forest clearings, Katyayani, Panhala, Radhanagari, Gaganbavada.

C. serratum (Linn.) Moon.—In grasslands, specially in forest clearings. Katyayani, Panhala, Radhanagari, Gaganbavada.

Duranta repens Linn.—A hedge plant.

Lantana camara Linn. var. aculeata (Linn.) Moldenke.—Common in Panhala.

Phyla nodiflora (Linn.) Green.—Common in moist places.

Stachytarpheta jamaicensis (Linn.) Vahl.—Rare. Near Tabak Udyan and Tin Darwaja, Panhala.

Vitex negundo Linn.—Very common around dwellings.

Lamiaccae:

Anisochilus carnosus Wall.—Very common in rainy season on tiled roofs.

Colebrookia oppositifolia Sm.-In forest clearings at Jyotiba

Dysophylla stellata Benth.—In puddles and marshes, Kolhapur, Panhala, Gaganbayada.

Hyptis suaveolons (Linn.) Point.—Gregarious in waste places, Kolhapur. Lavandula burmanni Benth.—Amongst grasses, Kolhapur, Panhala. Leonurus sibirius Linn.—Behind Jyotiba temple in waste places, Jyotiba. Leucas aspera Spreng.—Amongst grass at Kolhapur.

L. biflora R. Br.—Amongst grass at Kolhapur.

L. ciliata Benth.—In grasslands and forest clearings, Panhala, Gagan-bavada.

L. stelligera Wall. ex Benth.—In grasslands, Panhala, Gaganbavada.

L. urticifolia R. Br.—Kadamwadi near Kolhapur.

Plectranthus incanus Link.—Katyayani, Panhala fort (Rare).

Pogostemon plectranthoides Desf.—Gregarious in Panhala, Radhanagari.

Plantaginaceae:

Plantago major Linn.—Along Panchaganga river, Kolhapur.

Nyctaginaceae:

Boerhaavia diffusa Linn .-- Pretty common in Kolhapur.

Amaranthaceae:

Achyranthes aspera Linn.-Amongst grasses.

Aerva sanguinolenta (Linn.) Blume.—Forest edges, Panhala.

Alternanthera pungens H. B. S. K.—In dry rocky places, Kolhapur, Panhala.

A. sessilis (Linn.) DC.—A weed in damp and waste land.

Amaranthus spinosus Linn.—In waste lands, Kolhapur, Panhala.

Celosia argentea Linn.—Weed in fields.

Digera alternifolia (Linn.) Aschers.—In grasses and along road sides.

Gompherena celosioides Mart.—In waste lands, Kolhapur, Panhala.

G. globosa Linn.—Often found as an escape, University campus,

Kolhapur.

Chenopodiaceae:

Chenopodium ambrosioides Linn.-Weed in gardens, Kolhapur.

Polygonaceae:

Antigonum leptopus Hook. and Arn.—Cultivated but has run wild at Panhala.

Polygonum chinense Linn.—Very common in Panhala, Gaganbavada. P. glabrum Willd. —Marshes of Kolhapur, Shiroli Talao, Vadanage talao near Kolhapur.

P. plebejum R. Br.—Very common in all marshes and damp localities.

Podostemaceae:

Terniola zeylanica (Gardn.) Tul.--In streams of Ambaghat and Radhanagari.

Griffithella hookeriana (Tul.) Warming.—Near Gaganbavada in streams.

Piperaceae:

Piper hookeri Mug.-In forests of Ambaghat.

P. longum Linn.—In shady places along the bunds of sugarcane fields near Rankala.

Lauraceae:

Cinnamomum zeylanicum Blume area of Radhanagari forest. Alseodaphne semicarpifolia Nees.—Ambaghat.

Thymelaeaceae:

Lasiosiphon eriocephalus Decne.—Very common along forest clearings, Panhala, Radhanagari, Gaganbavada, Katyayani and Ambaghat.

Elacagnaceae:

Elaeagnus conferta Roxb.—Ambaghat on way to Pratapnagar.

Dendrophthoe falcata (Linn. f.) Etting.—Common on mangifera indica, Melilotus philippiensis at Panhala.

Viscaceae:

Viscum angulatum Heyne ex. DC.—On Dalvergia latifolia at Panhala, on Terminalia chebula at Radhanagari.

Santalaceae:

Oxyris wightiana Wall ex Wight...-In forest at Katyayani, Panhala. Santalum album Linn...-Panhala, Kolhapur (cultivated).

Euphorbiaceae:

Acalypha ciliata Forsk.--Grows in crevices of walls.

Bridelia samosa (Lamk.) Gehrm.—Common at Panhala.

Chrozophora rottleri (Geis.) Juss ex. Spr.—Weed in cultivated fields and puddles, Kolhapur.

Croton bonplandianum Baill.—A weed of waste land.

Emblica officinalis Gaertn.—Radhanagari forests.

Euphorbia geniculata Orteg.—In waste lands, Panhala.

E. hirta Linn.—Throughout on plains of Kolhapur.

E. neriifolia Linn.—On rocky slopes Ambaghat, Gaganbavada.

E. rothiana Spreng.—Amongst grasses in forest clearings, Gaganbavada.

E. thymifolia Linn.—Very common everywhere.

Glochidion hohenackeri Bedd.—Panhala, Radhanagari.

G. malabaricum Bedd.—Katyayani, Panhala.

Jatropha cureas Linn.-Near human habitation, Kolhapur, Panhala.

J. gossypifolia Linn.—In waste land in Rajarampuri.

Kirganelia reticulata (Poin) Baill.—In open places, Panhala.

Macaranga peltata (Roxb.) Muell.--Arg.--Radhanagari; Ambaghat.

Melanthesa turbinata (Rocn. ex Roxb.) Wight.—Along forest edges, Panhala, Gaganbavaoa.

Mallotus philippiensis (Lamk.) Muell. Arg.—Very common Panhala, Katyayani, Gaganbavada, Ambaghat.

Phyllanthus asperulatus Hutch.—In grasslands.

P. urinaria Linn.—Grassland, Kolhapur.

Sapium insigne Trimen.—Forest margins and clearings, Rajdindi road, Panhala, Gaganbavada; along streams near Amba Tanin Factory, Amba

Securinega leucophyrus (Willd.) Muell. Arg.—Common in open areas. Tragia muelleriana var. unicolor (Muell. Arg.) Pax and Hoffm. Under shades of forest trees.

Ulmaceae:

Celtis cinnamomea Lindl.—Very common in Panhala but not in other areas of Kolnapur district.

Trema orientalis (Linn.) Blume.—Common, Panhala, Kolhapur.

Moraceae:

Ficus asperrima Roxb.—A common shrub at Panhala.

F. glomerata Roxb.—Cultivated.

F. rumphii Blume. - Common along fort walls, Panhala

F. tsiela Roxb.—Cultivated at Panhala.

Urticaceae:

Boehmeria scabrella (Roxb). Gaud.—Stinging herb in shades. Fleurya interrputa (Linn.) Gaud.—Common on old walls.

Girardinia zeylanica Decasne.—In waste land during rains.

Lecanthus peduncularis (Wall.) Bedd.—Succulent herb in walls and

moist localities.

Pilea microphylla (Linn.) Liebm.—Naturalized in damp places, Kolhapur, Panhala.

Pouzolzia zeylanica (Linn.) Benn.—In rocky moist areas of Gaganbayada.

P. pentandra Benth.—Along streams.

Salicaceae:

Saliz tetrasperma Roxb.-Along river beds and streams, Kolhapur, Malkapur.:

Ceratophyllaceae:

Ceratophyllum demersum Linn.—Common in all lakes.

Hydrocharitaceae:

Blyxa octandra (Roxb.) Planch. ex. Thw.—Submerged herbs with purplish tufted leaves, in Kagal lake.

Hydrilla verticillate (Linn. f.) Royle.—All lakes, ponds and puddles of Kolhapur.:

Vallisneria spiralis Linn.—Common in water streams.

Burmanniaceae:

Burmannia pusilla (Wall, ex Miers.) Thw.-In pastures during September-October, Gaganbavada.

Orchidaceae:

Dendrobium barbatulum Lindl.--Common in forests of Panhala. Radhanagari and Ambaghat.

D. microbulbon A. Rich.—Near Gohlana, Radhanagari.

Eria dalzellii Lindl.—Radhanagari, Ambaghat.

Eulophia pratensis Lindl.—Marshes of Kagal lake.

E. nuda Lindl.—In shades of forest trees, Ambaghat.

Habenaria comme linifolia Wall. ex. Lindl.-Grasslands,.

H. grandiflora Lindl.—In grasslands, very common. H. longicalcarata A.—Dense grasslands, Kolhapur.

H. marginata Coleb.—In rice fields, Kolhapur, Panhala.

Oberonia recurva Lindl.—On trees at Panhala, Gaganbavada, Radha nagari and Ambaghat.

Vanda parviflora Lindl.—Panhala, Radhanagari.

Zingiberaceae:

Curcuma inodora Grah.—Very common along forest edges, Panhala. Gaganbavada, Radhanagari.

Curcuma sp. Undergrowth in dense forests, Panhala, Radhanagari.

Hedychium coronarium Koen.-Kolhapur.

Zingiber cernuum Dalz.--Undergrowth in dense forests, near Gaganbayada.

Costaceae:

Costus speciosus ((Koenig) Smith.—Common along forest edges, Panhala, Gaganbavada, Radhanagari, Ambaghat.

Cannaceae:

Canna indica Linn.—An escape.

Musaceae:

Ensete superbum (Roxb.) Cheesman .- Along ghat slopes.

Hypoxydaceae:

Curculigo orchioides Gaertn.—In open grasslands and forest clearings. Hypoxis aurea Lour.—Common in pastures.

Amaryllidaceae:

Crinum latifolium Linn.-Along streams, Kolhapur, Katyayani.

Agavaceae:

Agave vera-cruz Mall.-Escape, Panhala.

Dioscoriaceae:

Dioscoria bulbifera Linn.-Common at Katyayani, Panhala, Gaganbavada, Radhanagari.

D. pentaphylla Linn:—In all forests.

Asparagus race mosus Willd. var. jave nica Baker.—Katyayani, Panhala, Gaganbavada, Ambaghat forest margins and clearings.

Asphodelus tenuifolius Car.-Weed in cultivated fields.

Chlorophytum glaucum Dalz.—Gaganbavaca, Radhanagari (Rare). C. lavum R. Br. Pasture lands of Kolhapur, Panhala.

Gloriosa superba Linn.-In forest clearings, Katyayani, Panhala, Ambaghat.

Iphigenia indica (Linn.) A Gray. -In grasslands, Panhala, Radhanagari. I. pallida Baker.—Common in pasture lands.

Ledebouria hyacinthiana Roth.—In pasture lands, Kolhapur, Radhanagari.

Smilax zeylanica Linn.—Common.

Urginea indica (Roxb.) Kunth.—Common in pasture lands of Kolhapur. Kagal.

Pontederiaceae:

Monochoria vaginalis (Burm. f.) Presl, ex Kunth.—Along marshes of Vadanage lake near Kolhapur; rare.

Eichhornia crassipies (Mart.) Solms.-Common along Panchaganga river, Rankala tank, puddles at Kolhapur.

Arecaceae:

Phoenix sylvestris Roxb .-- Along nalas at Kolhapur.

Carvota urens Linn.-In forests of Panhala, Gaganbavada and Ambaghat.

Pandanaceae:

Fandanus odoratissimum Linn. f.-Kagal stream near Kolhapur, Katyayani, Radhanagari along streams.

Typhaceae:

Typha augustata Bory and Chaub.—Common in marshes, Kolhapur, Kagal, Shiroli.

Araceae:

Ariopsis peltata Nimmo.—Generally epiphytic, sometimes in rock crevices, abundant at Panhala and Radhanagari.

Arisaema murrayi Hook.-Katyayani, Panhala, Gaganbavada.

Colocasia esculenta (Linn.) Schott.—An escape.

Pothos scandens Linn.-Forests of Radhanagari.

Lemnaceae:

Lemna paucicostata Hegalmaier.—In stagnant ponds at Kolhapur. Spirodella polyrrhiza (Linn.) Schleid.—Kolhapur.

Potamogetonaceae:

Potamogeton nodosus Poir.—In all tanks around Kolhapur, Shirali, Vadanage and Kagal.

P. pectinatus Linn.--Kagal Lake.

Najadaeceae:

Najas gramines Del.—Common in ponds.

Besides these wild plants, some other useful plants were introduced in Tabak baug at Panhala at the suggestion of Chhatrapati Shahu Maharaj of Kolhapur such as tea, coffee, ornamental gymnosperms like species of Cupressus torulosa etc. He also introduced some new plants at Dajipur and Radhanagati forests.

1.2. Grasslands of Kolhapur:

Kolhapur stands at an altitude of more than 2000. The winds in the end part of summer are quite heavy. Due to this soil layers on the top of trap rocks get eroded. The rocks contain small pebbles and poor unfertile sand and gravel. In monsoon a number of these areas allow grass to grow and form temporary grasslands in open areas and on waste lands. Grass also grows in denuded areas of forest, and on areas made barren by human interference. Prof. S. D. Mahajan has collected the grasses around Kolhapur and they are enlisted here. They contain fodder grasses, thatch grasses and some weeds. Some grasses such as *Ischemum* would be a good source of material for paper pulp. As indicated by Puri and Mahajan (1968) Radhanagari forest, particularly, would be a good source of species for several economic and medicinal purposes.

These grasslands around Kolhapùr contain many other plants also as given below:—

Orchidaceae				Flowering Season
Eulophia pratensis Lindl				NovFeb.
Zeuxine sulcata Lindl				DecJan.
Habenaria digitata Lindl				July
Habenaria murginata Coleb.				Aug.
Habenaria rariftora A. Rich.				July-Aug.
Habenaria grandiflora Lindl.	• •	• •		July
Amaryllidaceae:				
Hypoxis aurea Lour	• •	••	• •	July
Liliaceae :				
Asparagus racemosus Willd.				
var. Javanica Baker				
Iphigenia indica A. Gray				June-July
Ŝcilla indica Baker	••	• •	• •	May—July
Commelinaceae:				
Commelina nudiflora Linn				Dec.
Commelina bengalensis Linn.	•		• •	Aug.—Dec.
Commelina forskalaei Vahl.	• •	• •		Nov.

Orchidacea	e				Flowering Season
Aneilema nudiflora R. Br.					Sept.
Cynotis tuberosa Schultes	• •				Aug.
Cynotis fasciculata Schultes					SeptOct.
Cynotis cristata Schultes					Aug.—Oct.
Cynotis axillaris Schultes		••	• •		AugSept.
•	• •	••	••	• •	rag. popt.
Eriocaulaceae:					
Eriocaulon minutum Hook.		• •			AugSept.
Eriocaulon luzulaefolium M	art.	• •		• •	Sept.—Nov.
Cyperaceae:					
Cyperus pumilus Linn.				٠.	Sept.
Cyperus globosus All.					1
Cyperus pygmaeus Rottb.					Nov.
Cyperus diformis Linn.					Oct.—Jan.
Cyperus arenarias Retz.					Sept.—Nov.
Cyperus haspan Linn.					Oct.—Dec.
Cyperus compressus Linn.					SeptNov.
Cyperus aristatus Rottb.					Sept.
Cyperus iria Linn				٠.	Dec.
Cyperus nutans Vahl.		THE PARTY			Sept.
Cyperus eleusinoides Kunth	1				Sept.
Cyperus rotundus Linn.	* 1314		£3.	- +	Sept.—Nov.
Cyperus exaltatus Retz.	1864		(4)		Sept.
Maniscus panicaus Retz.			% ·		Sept-Oct.
Kyllinga triceps Rottb.			19	٠.	Sept.
Fimbristylis dichotoma Vah		SP14	7		Oct.—Apri.
Fibristylis aestivalis Vahl.	- VAL	ואה			Sept.—Dec.
Fimbristylis dishylla Vahl.	1913	1 55 3			Aug.:
Fimbristylis digitata Boeck.			- A		Oct.
Eleocharis capitata R. Br.	3.4	4217	32		Sept.
Scirpus grossus Linn.	Barrellin St.		10		Sept.
Scirpus squarrosus Linn.					Oct.—Dec.
Scleria hebecarpa Nees	सद्यम	ৰ সম	Ŧ		
Poaceae or Gramineae (Grus					
Pennisetum hohenacekeri H Setaria pollidifusca Stalf.	osches	t exste	ud.		
Pennisetum typhoides Stalf, Bajari).	(Local	Mara	thi nar	ne	
Setaria intermedia Roem. a name (Pandar).	and Sci	hult. M	[arathi		
Setaria italica Beauv. (LN.	Rala)				
Isachne australis R. Br.	,				
Tricholaena wightii Nees ex	steud.				Sept.
Panicum Punctatum Burn,					Nov.
Panicum isachne Roth.	٠.				Sept.—Jan.
Panicum miliare Lamk.				-	1
Digitaria sanguinalis Scop.	var, <i>cili</i>	<i>iaris</i> Pr	ain		•
Digitaria royleana Prain					Dec.
Paspalum compactum Linn					Oct.
Sporobolus diander Beauv.					•
Sporobolus indicus Br.					Oct.
Ēragrostis viscosa Trin.		• •		٠.	Oct.
Syn. E. tenella Woodr.					
Eragrostis interrupta Beauv	var.	Koer	iigii S	tapf	
Eragrostis anabilis Wt. and	i Arn.	• •			Sept.—Nov.

Orchidaceae				Flowering Season
Eragrostis major Host Melanocenchrus jacquemontii Jau syn. Garcilea royleana Hook. i	ıb	••	••	Nov.—Jan.
Cynodon dactylon Pers	 	•••	•••	OctNov. OctNov. OctNov. Jan. Sept.—Nov.
Eleusine coracana Gaertn. Dinebra retroflexa Pazer. Hygrorhiza aristata Nees Oryza sativa Linn. Oropetium thomaeu Trin. Bambusa arundinacea Willd. and Dendrocalamus strictus Nees, Wi Dendrocalamus giganteus Munro	lld. an	d cult.	••	Aug. April
Bambusa nana Roxb. Zeamays Linn. Triticum sativum Lam. Cymbopogon Cartini Stapf. Andropogon helepensis Brot. Cymbopogon montanus Trin. Echinocloa colonum Link: Eromopogon faveolatus Stapf Michrochloa indica Beauv. Unochola halopus Stapf.			•••	Dec. OctNov. OctNov.

1.3. Aquatic Vegetation around Kolhapur:

There are a number of lakes and ponds in low lying areas around Kolhapur. In fact, Kolhapur is said to be a city of lakes and ponds, but many have not been investigated botanically. One such lake which has been investigated is the lake supplying drinking water to Kagal town, well-known as the home of the late Gopal Krishna Gokhale.

This lake known as Jaysingrao Talao of Kagal was constructed by the Kagal municipality in 1894. It is about 16 kilometres to the south of Kolhapur a little away from Pune-Bangalore road. It is about 565.7 metres above sea level, close to Kagal town. It is fringed by two hillocks on eastern and southern side, 51.2 metres long and 4.5 metres high. It is almost at the ground level on the western side. It occupies 76 acres of land and is a part of original perennial lake. It is filled by soil from the hill tops and ollurium from surrounding perennial sources of water. It maintains about 9 metres of water all the time in summer. It gets cut off into puddles in summer but maintains constant supply of water of 18" above soil in an area of 6.4 km. Soil is poor and gravelly except on the north, eastern and western border, where it is alluvial, rich in humus and clay. Average rainfall is 687 mm-812 mm and mean monthly temperature 88°F. Average relative humidity is from 83 to 63% in the morning and falls to 68-32% in the evening. The lake is full of angiosperms split into 11 plants associations. There are about 140 species.

Dicotyledons	Season		Habit	Growth Period
Capparidaceae	Seasonal Do. Do. Do.	•••	Erect Marshy Prostrate	
Polygalaceae: Polygala chinensis Linn			Do	Oct.—March
Portulaceae : Portulaca oleracea Linn.	Annual		Do	Throughout year
Elatinaceae : **Bergia ammannioides** Roxb.	Do.		Marshy	Aug.—Oct.
Malvaceae: Sida acuta Burm	Do.		Do	NovDec.
Tiliaceae: Chorchorus olitorius Linn.	Erect		Seasonal	Sept.—Dec.
Linaceae: Linum musorense Heyne	Seasonal		Erect	Oct.—Dec.
Zygophyllaceae: Tribulus terrestris Linn	Annual		Prostrate	Throughtout year.
Heylandia latebrosa DC. Crotalaria burhia Ham. Indigofera linifolia Retz I. cordifolia Heyne I. trifoliata Linn. Alysicarpus tetragonolobus	Do. Do. Annual Do. Annual	V	Prostrate Do Prostrate	AugSep. Sept.—Feb. Oct.—Feb. July-Oct. Aug.—Dec. Aug.—Oct, AugSept.
Edgew. Aeschynomene indica Linn.	Seasonal		Erect	Aug.—Dec.
	Seasonal		Erect	Aug.—Dec.
Lythraceae: Ammannia baccifera Linn. A. multiflora Roxb. A. salicifolia Monti. Rotala rotundifolia R. tenuis	Seasonal Do. Do. Do. Do.		Erect-marsh Do Do Do	ny Nov. OctNov. Oct.—Nov. Oct.—Nov. Oct.—Nov.
Onagraceae: Ludwigia octovalvis	Do.		Do	Aug.—Oct.
Cucurbitaceae: Citrullus colocynthis Schra	Do. ad. Do.	•••	Do Creeping	Aug—Oct. Sept.—Dec.
Ficoideae; Mollugo hirta Tnom M. pentaphylla Linn	Annual Do.		Prostrate Do	SeptOct. SeptNov.

	FLORA OF I	JESH	551
Dicotyledons	Season	Habit	Growth Period
Glinus oppositefolius Trianthema monogyana Linn.	Annual . Do		Sept.—Nov. June—Aug.
Rubiaceae . Dentella repens Forst Spermacoce stricta Linn. S. hispida Linn. Oldenlandia corymbosa Linn.	Seasonal. Do		_ *
Asteraceae:			
Asteraceae: Acanthospermum hispidum Linn. Xanthium strumarium Lint Caesulia axillaris Roxb. Cathocline spp. Glossocordialinieari folia Cass. Eclipta prostrata Linn. Echinops echinatus Roxb. Spilanthes acmella Murr.			
Lobeliaeae:	SEE LAND	199	
Lobelia trigona Roxb	Seasonal	Erect	Aug.—Oct.
Gentianaceae: Nymphoides cristatum Kunth. N. indicum Kunth Exacum pumilum Griseb. E. pedunculatum Linn. E. lawii C. B. Clarke Centaurium centaurioides Canscora diffnea R. Br. C. decurrens Concanensis Clarke	Perennial Do. Seasonal Do. Do. Do. Do. Do. Do. Do.	Do Do Do Do Do Do	Sept.—Apr. Sept.—Apr. AugSept. Dec. Oct. Sept.—Apr. Oct.—Jan. Oct.—Dec. Aug.—Oct.
Boraginaceae.	_		
Heliotropium ovalifoliumr Fork. Coldenia procumbens Linn.	Do Do	Prostrate . Do	JanFeb. SeptOct.
Sericostoma pauciflorum Stocks.	Do	. Do	NovDec.
Trichodesma indicum R. Br	Do	Erect	Aug.—Oct.
Convolvulaceae:			
Merremia emarginata Hali.	Perennia!	Prostrate	SeptOct.
Solanaceae Solanum nigrum Linn S. xanthocarpum Schd.	Annual . Do	. Erect Prostrate	Sept.—Jan. June—August

-						
Dicotyled	ons	Season		Habit		Growth Period
Scrophulariaceae : Bacopa monniera Wettst.	(L)	Annual	• •	Erect Prostrate.		June-Jan.
Celsia coromand	leliana	Do.		Erect .		Jan.—Oct.
Vahl. Sutera dissecta Rot Stemodia vicosa Ro Sopubia delphinifot Don.	xb.	Do. Do. Do.	•••	Do.	•••	Sept.—Feb. Sept.—Dec. Aug.—Oct.
Striga densiflora Be S. euphrasioidea Be Limnophila hetero Woods.	nth.	Do. Do. Do.	•••	Do.	us	Aug.—Nov. Aug.—Nov. Oct.—Nov.
Acanthaceae: Hygrophila auricula	nta	Do.		Erect- Marshy.		JunJan.
Lepidogathis cristat Willd.	а	Seasonal		Prostrate		Oct.—-Mar.
Rungia linifolia Nec	es	Annual		Sub-erect		Oct.—Dec.
Verbenaceae : Phyla nodiflora (L.) Green. (—Lippia nodiflor	6	Do.		Prostrate		All the year.
Labiateae : Lavendula burmann. Benth.	i	Seasonal	I	Erect		OctNov.
Leucas lavendulaefo	olia	Annual	17	Do.		Sept.—Nov.
Ocimum americanu O. sanctum Linn.	m Linn.	Do. Do.	सम्ब		••	Aug.—Oct. Aug.—Oct.
Nyctaginaceae: Boerhaavia diffusa	Linn.	Do.	••	Prostrate		Aug.—Nov.
Amaranthaceae: Amaranthus viridis A. spinosus Linn. Gomphrena celosioi Alternanthera sessil Lamk.	des	Do. Do. Do. Do.	• •		•••	Sept. NovDec July—Jan.
Polygonaceae : Polygonum plebejun R. Br.	n .	Do.	••	Do.	• •	July-Dec.
Euphorbiaceae Euphorbia hirta Lin Chrosophora prostre Dalz.	ata	Do. Seasonal	••	Do. Do.	• •	All the year. Aug.—Nov.
Phyllanthus niruri L	inn.	Do.	• •	D_0	••	July-Aug.
Monocotyledons:						

Hydrocharitaceae:
Hydrilla verticillata Prest.

Dec.

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Dicotyledons	Season	Habit	Growth Period		
Vallisneria spiralis Linn. Blyxa roxburghii Rich.	Annual Do	Prostrate Do	Sept.—May. Feb.		
Orchidaceae: Habenaria grandiflora	Perennial	Erect	July		
Lindl. H. longicormiculata	Do	Do	SeptOct.		
Blater and McC. Eulophia pratensis Lindl.	Do	Do	NovFeb.		
Liliaceae: Scilla hyacinthia (Roth)	Do	Do	July—Sept.		
Bc. Br. Urginea indica Kunth Chlorophytum laxum R. Br.	Perennial Do	Do	T 1 A		
Commelinaceae: Cyanotis tuberosa Schult. C. fusciculata	Do Seasonal	Creeping Erect			
Typhaceae: Typha angustata Borg.	Percanial	Amphibious	Aug.		
Potamogetoniaceae: Potamogeton indicus	Annual	Aquatic	Sept.—Dec.		
Roxb. P. perfoliatus L	Do	Do	Dec.—Feb.		
Najadaceae: Najas minor All.	Do	Do	Aug.		
Eriocaulaceae: Eriocaulon dianae Fyson:	Seasonal	Erect Marshy.	AugSept.		
Cyperaceae					
Cyperus globosus All	Auunal		ny AugSept.		
C. numilus L	Do Perennial	Do	A * * * * * * * * * * * * * * * * * * *		
C. tegetum Roxb	Annual	Do	A / D		
C. iria L. C. malabarius C. B. Cl.	Do	Do	AugSept.		
C. pygmaeus Rottb	Do	Do	SeptOct.		
C. castaneus Wild	Do	Do	Oct.—Dec.		
C. uncinatus Poir	Do	Do	Sept.—Dec.		
C. flavidus Retz.:	Do	<u>D</u> o	AugSept.		
C aristatus Roxb	Do	Do	AugSept.		
C eleusinoides Kunth	Do	Do	Sept.		
Scirpus littoralis Schrad	Do	Do, Do	Aug,—Oct. Sept.		
Fleocharis histulosa Link	Do Do	Do	Sept.		
E. atro-purpurea Kunth.		Do	AugSept.		
Fimbristylis guinguangular F. tetragona R. Br.	Do	Do	A Clamb		
Finbristylis dichotoma	Do	D-	Court Oat		
Vahl. F. monostrehya Hask F. woodrowii C. B. C.I	Do	Do Do	July-Aug. Aug.—Oct.		

Dicotyledons	Season	Habit	Growth Period
F. tenera Schult. F. diphylla Vahl. F. spathacea Roth. Cyperus triceps Rottb. Fuierena wallichiana Kunth.	Perennial Annual Do Do Do	Erect-Marshy Do Do Do Do	Sept. Aug. AugSept. AugSept. AugSept.
Rhynchospora wallichiana Kunth.	Do	Do	Aug.
Poaceae (Gramineae)			
Saccharum spontameum L.	Perennial	Do	Sept.—Oct.
Cymbopogon martini Roxb.	Do	Do	Dec.—Apr.
Paspalidium geminatum Staf.	Do	Floating-	Oct.—Mar.
Erogrostis interrupta Beauv.	Do	Erect- Marshy,	FebMar.
Cenchrus Sp	Do	Do	FebMar.
Isachne elegans Dalz	Do	Do	DecMar.
Arundinella Sp	Do	Do	Feb.
Échinochloa colona L	Do	Erect Aquatic.	Oct.—Mar.
Sporobolus Sp	Do	Erect- Marshy	Oct.

1.4. Plants of Radhanagari Forest and Bhogayati River Bed:

The main forests of Kolhapur where a large number of plants are concentrated lie to the west and south-west of Kolhapur. It is a strong hilly region and extends through Chandagad to Padgaon forests. The average rainfall varies from 35" to 300". Chandagad range is Naturally the vegetation there is quite dense. very rich in plants. Radhanagari lies at 16° 30' North and 74° East. Altitude of the Radhanagari taluka varies from 549 m to 915 m (1800-3000), slopes are steep. Sometimes even 365.7 m high. Especially they are so in the southern region. The table-land on the mountain gets maximum There are a number of offshoots from the north-eastern ranges of Sahyadris. The small rivers like Dhamani and Tulsi, and large rivers like Bhogavati and Doodhganga flow through the hilly region. The lead of Bhogavati river is turned into a huge zigzag lake having an area of 1641 hectares., called Marmitalav built in 1951. Another lake is being constructed to the south of Radhanagari on Doodhganga river. The soil is lateritic, shallow and poor because of high precipitation and erosion. During monsoon it is over saturated with water. But soon after the monsoon it completely dries up. Bauxite is found at many places near about and is known to be not a very good promoter of plants. Mean maximum temperature in summer in May is 37.º 22°C and minimum 21°.11°C, the humidity then being 20-50 per cent. During monsoon it goes up to 90-100 per cent as the temperature falls in July. autumn in November mean maximum temperature is about 26°.66°C and minimum 12°-22°C respectively, humidity being 60-80 per cent. Temperature falls to 21°.68°C in January and 16°.11°C. Mean maximum humidity 20-40 per cent. Rainfall due to south-west quite high, 3810 mm. (152"). Dajipur-Gaganbavada range lies to its The rainfall however abruptly comes down to 2540 mm within a distance of 16 km. to the east.

The forest is evergreen. It contains tall trees but here the intensity of light is low. There are barren lands and patches of deciduous forests and even scrub on the eastern parts of Radhanagari forest due to human interference. In the previous regime grass and forest were preserved and a game sanctuary for large animals like bison, bear, boar and tiger was created. Birds also lived to the north of Radhanagari. Towards the west there are sub-tropical forests known as Dangs where many plants are preserved in Dev Raies. They have been described by Sharma and Kulkarni (1981).

The vegetation here is evergreen in the hilly regions and in deep valleys. Dangs have sub-tropical forests. A special feature of vegetation is two layers of canopy. The under-growth is not much, but wherever it occurs it is abundant. The upper canopy consists of trees of Syzygium cumini, S. hemisphericum, Lagerstroemia parviflora, Actinodaphne hookeri, Litsea Stocksii, Cinnamomum zeylanicum, Nephalium longana, Holigarna grahami, Ochrocarpus longifolius, Garcinia indica, Eleocapups oblongus, Amoora lawii, Alstonia scholaris, Symplocos beddomei, Ficus glomerata and Hymenodictyon obovatium. The second canopy consists of Memecylon umbellatum, Mappia foetida, Clausena indica, Syzygium zeylanicum, S. caryophyllatum, Ixora nigricans, Diospyros candollana, Linociera malabarica, Olea dioca, Glochidion hohenackeri. Where the soil has shade below, shrubs of Grewia levigata, Gymnosporia rothiana, Lasiosiphon eriocephalus, Leea macrophylla, Casearia graveolens, Pogostemon parviflorus, Mallotus stenanthus are found. Outside the thick growth of shrubs of Carvia callosa, Strobilanthes sessilis, Impatiens latifolia, I. pulcherrima, Crotolaria retusa, Solanum giganteum, Gallicarpa lanata, Lobelia nicotianaefolia, Maesa indica, Rauwolfia densiflora, Justicia betonica, Vitex negundo, Ficus hispida, Pteridium aquilinum, Habenaria longicalcarata, Platanthera sussannae, Curcuma psuedomontana, Osbeckia truncata, Begonia crenata are common, besides several grasses like Eragrostis amabilis, Themeda quadrivalvis, Aristida setacea, Setaria glauca, Aristida setacea, Apluda aristata, Paspalum compactuam. Many climbers like Clematis malabarica, C. gouriana, Gnetum ula, Capparis moonii, Scutia indica, Vitis pentaphylla may be mentioned. Outside the shruby layer, Calycopteris floribunda, Rubia cordifolia, Piper hookeri, Smilax macrophylla, Calamus pseudotenuis and Asparagus racemosus are common. In denuded areas and in open places dry deciduous plants are found, Carissa carandas. This Comprises dry deciduous type of vegetation Tectona grandis, Anogeissus latifolia. Woodfordia fruticosa and grass. The Radhanagari forests are similar to forests of Padgaon and Dajipur and are quite rich in plants. They provide good timber in the Chandagad area and also fuel from species other than Tectona grandis. They contain tropical evergreen plants and also some semi-evergreen and dry habitat Many of them are also found in Goa, North Canara and Malabar plants. forests. It is quite a good representative of evergreen forest in Maharashtra. It is richer than Khandala in plant species. There are many medicinal plants also. The area compares well with Sawantwadi area. The list of plants found in Radhanagari forests and Bhogavati river bed collected by Prof. S. A. Parandekar is given here. It may be compared with similar list of Padgaon and Khandala plants which will show the richness of the flora here.

Enumeration of plants from Radhanagari dam area and along the bed of Bhogavati river:—

Ranunculaceae:

Clematis gourinana

A-127-36-A.

Papavaraceae:

Argemone mexicana

Malvaceac:

Sida veronicifolia Kydia calycina Bombax malabaricum

Malpighiaceae: Hiptage madablota

Geraniaceae:
Oxalis corniculata

Olacaceae:
Mappia foetida

Vitaceae: Leea latifolia

Papilionaceae:
Cylista scariosa
Dalbargia volubilis
Derris scandens

Menispermaceae:
Stephania hernandifolia
Cyclea busmanni
C. peltata

Sterculiaceae: Helicteres isora

Tiliaceae:

Erinocarpus nimmennii Triumfetta pilosa T. rhomboidea

Rhamnaceae: Zizyphus rugosa

Anacardiaceae:

Anacardium occidentale Semicarpus anacardium Holigarna grahami

Mimosaceae:
Acacia
Acacia concinna

Combretaceae:
Terminalia bellerica
T. paniculata

Myrtaceae:

Eugenia lanceolata
E. coymbosa

Turnera ceae:
Turnera ulmifolia
A-127—36-B.

Rubiaceae:

Anthocephalus indicus Mitragyna parvifolia Wendlandia notoniana Oldenlandia corymbosa Randia dumetorum Gardenia lucida Vangueria spinosa Pavetta indica

Apocynaceae:

Plumeria acutifolia Carissa carandas (C. congesta)

Caesalpineae:

Wagatea spicata Cassia fistula Bauhinia Sp. Ammania multiflora Woodfordia fruticosa

Umbelliferae:

Carum stictocarpum Hydrocotyle asiatica

Compositae:

Senecio edgeworthii Sphaeranthus indicus S. africanus Eclipta erecta Elephantopus scaber Tricolepis glaberrima

Oleaceae:

Jasminum malabaricum

Asclepiadaceae:

Hemidesmus indicus Cryplolepis buchanani

Gentianaceae:

Erythraea roxburghii Canscora diffusa Canscora decurens

Solanaceae:

Solanum indicum

Acanthaecae:

Blepharis asperrima
Asteracantha longifolia
Daedalacanthus roseus
Strobilanthes callosus
Haplanthus tentaculalus
Lapidagathis cristata
Rungia parviflora var pectinata
justicia betonica



Amarantaceae : Achyranthus aspera

Polygonaceae: Polygonum chinensis

Thymeliaceae:

Lasiosiphon eriocephalus

Loranthaceae: Loranthus longiflorus

Asclepiadeceae:
Asclepias curasavica

Hydrophyllaceae: Hydrolea zeylanica

Convolvulaceae: Argyreia speciosa

Lentibulariaceae: Utrcularia coerulea

Verbenaceae:
Lantana camara
Callicarpa lanata
Tectona grandis
Vitex negundo
Clerodendron serratus

Labiatae:

Pogostemon parviflorus
Dysophylla stellata
Colebrookea oppositifolia
Leucas stelligera
Leucas ciliata
Pogostemon purpurascens

Urticaceae: Ficus religiosa L.

Orchidaceae:

Vanda roxburghii 1 Br.

Aerides crispum Lindl.

Dioscoreaceae : Dioscorea hispide

Liliaceae: Similax macrophylla Roxb.

Typhaceae:
Typha augustata Bory.

Euphorbiaceae:
Bridelia stipularis Bl.
Phyllanthus emblica L.
Jatropha curcas L.
Homonoia riparia Lour.
H. retusa Muell

Pandanaceae:

Pandanus furcatus Roxb.

Eriocauliaceae:

Eriocaulon sp.

1.5. Plants of Padgaon Forest:

Another important area in Kolhapur district where there is plenty of vegetation is Padgaon in Bhudargad taluka. There is good forest and the plants found here are given below through courtesy of the late Professor S. A. Parandekar. The vegetation is easily comparable with that of Radhanagari, Mahabaleshwar or Khandala. Radhanagari and Padgaon forests form typical pockets of evergreen forests. This list is worthy of note for the following evergreen species and some moist deciduous plants such as Leea sambucina, Dillenia indica, Crotolaria retusa, Garcinia indica and Gardenia malbaricum, Ochocarpus longifolius, Mesua ferreia, Mappia foetida, Salacia pironoides, Holigarna arottiana, Nothopegia, Colobrookia, Lobelia nicotianaefolia, Symplocos beddomii, Ixora nilgireans, Ligustfrum nilgiriensis var ovata. Oxoxylum indicum, Hydnocarpus, wightrana Piler nigrum, (Cinamomum zeylanicum, Eleagnus latifolia, Bryonia pilrea.) Macranaga roxburghii, Sapium insigne, Salix tetrasperma.

Enumeration of Important Plants in Padgaon Forest

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Ranunculaceae:

Clematis gouriana Roxb.

Magnoliceae:

Michelia champaca L.

Papavaraceae:

Argemone mexicana L.

Cappridaceae: Capparis moonii

Bixaceae:

Flacourtia montana Grah.

·Malvaceae:

Sida rhombifolia Mast. Urena lobata Hibiscus furcatus Abutilon polyandrum Bombax malabaricum

Rutaceae:

Xanthoxylum triphyllum Wt. Glycosmis pentaphylla Murraya exotica Luvunga eleutherandra: Atalantia monophylla:

Rhamnaceae:

Zizvphus rugosa

Vitaceae:

Vitis elongata V. trifolia Leea sambucina

Moringaceae:

Moringa pterygosperma

Cannaraceae:

Cannarum strictum

Papillionaceae::

Heylandia latebrosa Crotolaria retusa

Dilleniaceae:

Dillenia indica

Menispermaceae:

Cocculus macrocarpus Stephania hernandifolia Cyclea burmanni

Guttiserae ::

Garcinia indica Garcinia malabarica Ochrocarpus longifolius Mesua ferrea

Sterculiaceae:

Sterculia villosa

Tiliaceae:

Grewia sp.
Triumfetta rhomboidea
Elaeocarpus munroii

Meliaceae:

Dysoxylum binectariferum

Oleaceae:

Mappia foetida

Celastraceae:

Celastrue paniculata Gymnosporia rothiana Salacia prionoides

Sapindaceae:

Allophylnus cobbe Hemigyrosa canescens

Anacardiaceae:

Mangifera indica Anacardium occidentale: Holigarna arnottiana Nothopegia colebrookiana Spondias mangifera

Caeselpineae: Cassia fistula

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Papillionaceae:

Erythrina indica
Butea frondosa
Atylosia lineata
Cylista scariosa
Flemingia bracteata
Dalbergia latifolia
D. volubilis

Myrtaceae:

Eugenia lanceolata E. heyneana E. jambos Careya arborea

Samydaceae:

Casearia graveolens

Umbelliferae:

Carum stictocarpum Hydrocotyle asiatica

Compositae:

Elephantpus scaber Cyathocline lyrata Sphaeranthus indicus Senecio edgeworthii Tricholepis glaberrima

Lobeliaceae:

Lobelia nicotiananefolia

Myrsinaceae:

Maesa indica Embelia robusta Ardisia solanacea

Styraceae:

Symplocos spicata

Apocynaceae:

Carissa congesta Wrightia tomentosa Tabernaemontana crispa Plumeria acutifolia Cerbera thevetia

Caesalpineae:

Cesalpinia nuga Wagatea spicata Bauninia sp. Acacia pennata

Crassulaceae:

Bryophyllum calycinum

Rhizophoraceae:

Carallia integerrima:

Combretaccae:

Terminalia chebula Terminalia bellerica Terminalia tomentosa Terminalia paniculata

Melastomaceae:

Memecylon edule

Lythraceae:

Lageistroemia lanceolata

Cucurbitaceae:

Melothria heterophylla

Araliaceae:

Heptapleurum venulosum

Rubiaceae:

Oldeniandia corymbosa
Wendlandia notoniana
Mussaenda frondosa
Randia dumetorum
Vangueria spinosa
Ixoro nigricans
Pavetta indica
Rubio cordifolia
Canthium umbellatum

Sapotaceae:

Sideroxylon tomentosum

Oleaceae:

Jasminum malabaricum Loniciera intermedia var. roxburghii Lingustrum neilgherrense var. ovata

Asclepiadaceae:

Hemidesmus indicus Hoya wightii Daemia extensa

Gentianaceae:

Exacum bicolor Canscora diffusa Erythraea roxburghii

Bigoniaceae:

Oroxylum indicum Stereospermum chelonoides:

Verbenaceae:

Lantana camara
Callicarpa lanata
Tectona grandis
Vitex negundo
Clerodendron serratus

Polygonaceae:

Polygonum chinensis

Podostemonanceae: Hydrobryum lichenoides

Piperaceae Piper nigrum

Lauraceae:

Cinnamomum zeylanicum

Elaeagnaceae: Elaeagnus latifolius

Euphorbiaceae:
Euphorbia ligularia
Bridelia stipularis
Bridelia retusa
Bischofia javanica
Glochidion hohenackeri
Breynia patens
Macaranga roxburghii
Homonoia riparia
Tragia involucrata
Sapium insigne
Pedilanthus tithymaloides

Salicaceae: Salix tetrasperma

Boraginanceae: Cordia myxa

Convolvulaceae: Ipomoea companulata

Solanaceae: Solanum indicum

1.6. Important Plants of Gaganbavada:

Gaganbayada is the headquarters of Gaganbayada taluka, about 112 km NW of Kolhapur, and about 40 km further of Radhanagari. Part of it abutts on the edge of Sahyadri, but its greater part lies on Desh side. It is surrounded by hills which get dried up after rains. There are a few moist deciduous species like Garcinia xanthochymus but they are mixed with many dry deciduous plants. The vegetation is mixed deciduous. The place is much isolated from the rich evergreen vegetation of Radhanagari. There are a large number of plants of Terminalia chebula, Vangueria spinosa, Terminalia bellerica, T. paniculata, shrubs of Strobilaenthes perfoliantus, Mappia foetida, small stunted trees of Memecylon edule, Lasiosiphon eriocephalus, Scutia indica, Calycoteris floribunda etc. Capparis moonii, Nothopegia colebrookeana, Hura eriptans, Eleagnus latifolia. These are remarkable. With Phonda ghat on the north and Amboli down south, the place is full of plants, but all in isolated patches. Sapindus laurifolius and Celastrus paniculata are common. The vegetation is more or less like that of Bhaja or Karla behind the high rainfall zone of Khandala. Its mixed character is well brought out by the list of plants of Gaganbavada supplied by the late Prof. S. A. Parandekar. The main approach road to it is from Rankala at Kolhapur and there is

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one kutcha road also from Amba ghat top. The road gets washed away during rains. The area provides several thousands of bags of myrobalans to the Amba tannin factory at Amba. Some ground orchids are found on forest floor in shady places.

Plants of Gaganbayada

Rannuncalaceae:

Clematis gouriana Roxb.

Capparidaceae:

Capparis spinosa L. C. moonii Wt.

Guttiferae:

Garcinia xanthochymus Hk. f.

Malvaceae:

Hibiscus furcatus Willd.

Bombax malabaricum DC.

Abutilon polyandrum W. and A.

Tiliaceae:

Erinocarpus nimmonii Mochst, Grewia microcos L.

Rutaceae:

Murraya koenegii Spr. Glycosmis pentaphylla Corr. Atlantia monophylla DC.

Oleaceae:

Mappea foetida Miers

Celastraceae:

Celestrus paniculatus Willd.

Rhamnaceae:

Scutia indica Brongn.
Sapindus laurifolius Vahl.

Anacardiaceae:

Nothopegia celebroockiana Bl. Mangifera indica L.

Leguminosae:

Wagatea spicata Dalz, Erythrina indica Lam Butea monosperma Konig, Alysicarpus longifolius W. and A.

Rhizophoraceae:

Carallia integerrima DC.

Combretaceae:

Cambretum ovalifolium Roxb. Terminalia bellerica Roxb. T. chebula Retz T. paniculata Roth. Myrtaceae:

Eugenia jambolana Law

Melastomaceae:

Me mecylon edule Roxb.

Lythraceae:

Woodfordia fruticosa Salisb.

Umbelliferae:

Carum strictocarpam Clarke

Rubiaceae:

Cantheum umbellatum Wt.

Ixora nigricans Br.

Vangueria spinosa Roxb.

Plectronia rheedei Bedd.

Randia dumetorum Lam.

(= Xeromphis spinosa):

Compositae:

Cyathocline lyrata Cass.

Myrsinaceae:

Maesa indica Wall.

Apocynaceae:

Tabernaemontana crispa Dalz.

Carissa congesta L.

Asclepidaceae:

Calotropis gigantea

Solanaceae:

Solanum indicum L.

Scrophulariaceae:

Limnophylla heterophylla Woodr.

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Bignoniaceae:

Heterophragma roxburghii DC.

Acanthaceae:

Strobilaenthes perfoliatus T. Anders

Lepidagathis lutea Dalz.

Asteracantha longifolia Nees

Haplanthus verticilitus Nees

Verbinaceae:

Vitex negundo L.

Labiatae:

Pogostemon parviflorus Bth.

Leucas stelligera Wall.

Pysophylla stellata Bth.

Amarantaceae:

Aerua scandens Wall.

Polygonaceae:

Polygonum chinense Grah.

Podostomaceae:

Podoste mon Sp. (?)

Thymeleaceae:

Lasiosiphon eriocephalus Dene

Euphorbiaceae:

Macaranga roxburghi Wf.
Eleagnus latifolius L.
Gymnosporia montana Benth.
G. rothiana Law
Glochidium hohenackeri Bedd.

Orchidaceae:

Dendrobium barbatum Lind. Vanda roxburghii Br.

Liliaceae:

Asparagus racemosus L. var. gavanica Baker

Palmae:

Phoenix sylvestris Roxb.

1.7. Dev-Raies in Kolhapur District:

Near Radhanagari area there is a 'Dev-Rai' or simply called 'Rai' which has been studied by Sharma and Kulkarni (1980). These Dev Raies are peculiar conserved sacred groves of plants, generally trees, in western ghats. People are prohibited, under the fear of curse from God or Deity of the Rai, cutting any tree or other plants in Dev Raies. There are about 250 such Dev-Raies all along the Western Ghats. Most of them contain a small number of evergreen, some semi-evergreen moist deciduous and some dry deciduous plants. For example Clausena indica, Evonymus indica, Naravelia zeylanica, Persea gratissima, Holigarna grahamii, Luvunga sarmentosa, Syzygium hemisperma are evergreen. Strychnos maximia, Olax wightiana, Garoinia talbotii, Prunus zeylanica, Salacia macrosperma are semi-evergreen and others are deciduous.

The vegetation that they represent is entirely different from that in the surrounding area. In Kolhapur district there are a number of Raies: one each in Gaganbavada, Radhanagari, Gargoti, Ajra and two-three in Chandagad taluka. Most of them lie in the catchment area of the Ghats. Many plants they contain are not to be seen in the surrounding nearby areas which are dry deciduous.

They have variable rainfall, more than 6700 mm at Gaganbavada, 1750 mm at Chandagad, about 1800 mm at Radhanagari. Other Raies mentioned by Sharma and Kulkarni (1980) are at Nerveli, Teliya Rai at Gaganbavada, one at Gargoti etc. Raies in Western Ghats were studied by Gadgil and Vartak (1975-1976).

Some rare plants, medicinal or endemic, are found in Raies e.g. Gnetum ula, Salacia macrosperma, Entada pursaetha, etc. All these Raies deserve full investigation. Raies in Chandagad, Gargoti, Hanuman-Ghat, Raies at Kitwade, Ajra, Asangaon, Ambabaichi Rai of Radhanagari are very famous and deserve critical survey and study.

They represent the relict or ancient tropical type of forest vegetation of the late Eocene period. They might have disappeared later due to subsequent changes in the climate in Miocene and Pleistocene periods, less rainfall and dryness. On account of less rainfall and hot temperature in Miocene and low temperature and cold waves in Pleistocene plants died. They were revived to their present status after the Quaternary period.

	Botanical name	Local name	Remarks*
1. 2.	. •	Morvel Nakchini	_ ```
3.	ANNONACEAE: Uvaria narum (Bl.) Dunal	Saplilvel	Ev.
4.	MENISPERMACEAE: Diploclisia glaucescens (Bl.) Diels.	Remark	Sem.
5.	CAPPARACEAE : Capparis moonii Wt	Waghati	Sem.
6. 7.	FLACOURTIACEAE: Casearia esculenta Roxb Hydnocarpus pentandra (F. Ham.) Oken.	Modi	Sem. Sem.
8. 9.	CLUSIACEAE: Garcinia talbotii Raiz. ex. Sant. Mammea suriga (Buch. Ham. ex Roxb) Kosterm.	In it	
10.	ANCISTROCLADACEAE: Ancistrocladus heyneanus Wall, ex Grah	Karotal •••	Sem.
11. 12.		Bala, Jangli methi Van-Bhendi	MD. MD.
13.	STERCULIACEAE: Sterculia guttata Roxb	Goldar	Sem.
14.	TILIACEAE: Erinocarpus nimmonii Grah. ex Dalz and Gibs.	Chera	MD.
15. 16. 17.	Microcos paniculata L	Hasoli, Asolin	Sem. MD Sem.
18.	ELAEOCARPACEAE: Elaeocarpus serratus L.	Perinkan	Ev.
19.	MALPIGHIACEAE : Hiptage benghalensis (L.) Kurz		Sem.

^{*}Ec=Economic Importance, Ev=Evergreen, Sem=Semi-evergreen, Med=Medicinal, C=Common, D=Dominant.

	Botanical name	Local name		Remarks
20.	RUTACEAE: Atalantia racemosa Wt. and	Makadli mbu		Sem.
21. 22.		Bok	••	Ev. Ev.
23. 24. 25.	Metr. Luvungasarmentosa (Bl.) Kutz. Paramignya monophylla Wt Xanthoxylum rhetsa (Roxb) DC.	Makadi		Ev. Sem. MD., Med.
26. 27. 28.	MELIACEAE: Aglaia lawii (Wt.) Saldanha Dysoxylum binectariferum (Roxb.) Hook. f. ex Bedd. Trichilia connaroides (Wt. and	Kat, Burumb Kauti, Yerindi Limbara	•••	Sem.
20.	Arn.) Benth.	Limbara	••	Sem.
29.	OLACACEAE: Olax wightiana Wall. ex Wt. and Arn.	••		MD.
30.	ICACINACEAE: Nothopodytes foetida (Wt.) Sleum.	Amartya		Sem.
31. 32.		Kangun Sarpin	••	MD., Med. Ev., R.
33. 34.	Hippocratea grahamii Wt	Lokhandi Dhavsi	• •	Sem. Sem., Med.
35.	RHAMNACEAE : Scutia myrtina (Burm. f.) Kurz.	यते		Sem.
36. 37.	Ventilago bombaiensis Dalz. Zizyphus rugosa Lamk	Toran		3.55
38.	VITACEAE: Cissus woodrowii (Stapf ex Cooke) Sant.	••	••	MD.
39.	LEEACEAE: Leea indica (Burm. f.) Dinda Merr.			MD.
40. 41.	SAPINDACEAE: Allophlyus cobbe (L.) Racusch. Lepisanthes tetraphylla (Vahl) Radlk.	17.	••	MD, Sem,
42.	ANACARDIACEAE: Holigarna grahamii (Wt.) Kurz.	Ranbiba		Ev.
43. 44,	Mangifera indica L		 	Sem. Ev. MD.

	Botanical name	Local name		Remarks
45. 46.	CONNARACEAE: Connarus wightii Hook.f Rourea praineana Talb	L	••	MD. Sem.
47. 48. 49. 50.	FABACEAE: Crotolariu retusa L	Khajkuily		MD. MD. MD. Sem.
51.	CAESALPINIACEAE: Wagatea spicata Dalz	Wakeri	٠.	Sem., Med.
52. 53.	MIMOSACEAE: Acacia sinuata (Lour.) Merr. Entada pursaetha DC	a	• •	Sem.
54.	ROSACEAE: Prunus zeylanica (Wt.) Miq.	Uvala		Sem.
55.	CRASSULAEAE: Kalanchoe pinnata (Lamk.) Pers.	Ghaymari		MD.
56.	RHIZOPHORACEAE: Carallia brachiata (Lour.) Merr.	Phansi		Sem.
57. 58.	Terminalia bellerica (Gaertn.) Roxb.	Hela	••	Sem. Sem., Med.
60. 61.	MYRTACEAE: Syzygium cumini (L.) Skeels	Jambhul		MD., Ec. Ev.
62.	MELASTOMATACEAE: Memecylon umbellatum Burm.	Anjan	•	Sem., Ec.
63.	LYTHRACEAE: Lagerstroemia microcrapa Wt.	Nana		Sem. Ec.
64.	CUCURBITACEAE: Solena heterophylla Lour	Gometi	•	Med.
65.	ARALIACEAE: Schefflera venulosa (Wt. and Arn.) Harms,	Waghchawad .	•	Sem., Ec.
66. 67. 68.	RUBIACEAE: Canthium angustifolium Roxb. Ixora brachiata Roxb. I. niigricans R. Br. ex Wt. and Arn. Meyna laxiflora Robyns		•	Med. Med. Sem. MD.
U).	12 cylina ravigioi a 100 y 110	,	•	

	Botanical name	Local 1	name		Remarks
70.	Mussaenda glabrata (Hook. f.) Hutch.	Bhutkes	••		MD.
71. 72.	Randia rugulos (Thw.) Hook. f. Xeromphis spinosa (Thunb.) Keay.	Travelz Gela, Ku	ımbhal	••	Sem. MD. Med.
73.	ASTERACEAE: Ademostemma lavenia (L) O. Kuntze.		••		Sem.
74. 75.	Ageratum conyzoides L Blumea solidaginoides (Poir.)		• •	• •	MD. MD.
76. 77. 78.	DC. B. virens DC. Elephantopus scaber L. Vernonia divergens (Roxb.) Edgew.	Haran	••	 	MD. MD. Sem.
79.	MYRSINACEAE: Ardisia solanacea (Poir) Roxb.		••	• •	MD.
80. 81.	SAPOTACEAE: Mimusops elengi L Xantolis tomentosa (Roxb.) Raf.	Bakul			Sem. MD.
82. 83.	EBENACEAE: Diospyros candolleana Wt. D. oocarpa Thw	7		 	Sem. Ev., R.
84.	SYMPLOCACEAE: Symplocos racemosa Roxb	Dhamu,	Lodhya	ı	Sem.
85. 86. 87. 88.	Linociera malabarica Wall. ex	Kusar Kunjan,	 Kapshi	••	MD. MD. Sem. Sem.
89.	G. Don. Olea dioica Roxb	Pajarabl	าบไ	٠.	Sem., Ec.
90.	APOCYNACEAE: Aganosoma cymosa (Roxb) G. Don.	Sapli	••		Sem.
91. 92. 93. 94.	Carissa congesta Wt	Dik-vel, Karvand Nagalku	i 	ni 	MD. D., Ec. Sem. Sem., Med.
95.	Cooke. Holarrhena antidysenterica (1.)				D., Med.
96. 97.		Hadki Tagar		••	MD., Med. C.
98.	ASCLEPIADACEAE: Hoya wightii Hook. f				Sem.
9 9.	LOGANIACEAE: Strychnos colubrina L			••	MD.

	Botanical name		
		Local name	Remarks
100.	CONVOLVULACEAE: Merremial vitifolia (Burm. f.) Hall, f.	Navalichaval	MD.
101.	SOLANACEAE: Solanum indicum L	***	MD.
102.	BIGNONIACEAE: Heterophragna quadriloculare (Roxb.) K. Schum.	Varas	MD.
103. 104. 105.	ACANTHACEAE: Adhatoda ze ylanica Medik Barlenia prionitis L	Korati	C. C.
106.	Ble pharis asperrima Nees	** **	
107.	Dicliptera ze ylanica Nees	••	
107.	Ecobolium viride (Forsk.) Alston var. laetevirens (C. B. Cl.) Sant.	•• ••	Sem.
108.	Eranthe mum purpurasce ns Nees.		MD.
109.	E. roseum (Vahl) R. Br.		MD,
110.	Gymnostachyum glabrum (Daiz) T. Anders.		Sem.
111.	Haplanthus neilgherryenis Wt.		MD.
112.		W	MD.
113.	Le pidagathis fasciculata (Retz.) Nees.	17	Sem.
114.		1172	MD.
115.	Staruogyne zeylanica (Nees) O. Kuntze.		MD., R.
	VERBENACAE:	키식적	
116.	Callicarpa tomentosa (L.)	Bisur	MD.
117. 118.	Clerodendrum viscosum Vent.	Kodi, Bhandire Tantani, Ghaneri	MD.
	LAMIACEAE:	T'.1	~
119.	Ocimum sanctum L.	Tulas	C., Med.
120.	Pogoste mon purpurascens Dalz.	Pangla	MD.
121.	POLYGONACEAE: Polygonum chinense L	• •	MD.
122.	PIPERACEAE: Pipper trachostachyon (Miq.) DC.	Mir-vel	MD.
123.	MYRISTICACEAE: Knema attenuata (Hook. f. and Thoms) Warb.	Ran-Jaiphal	Sem.
124.	LAURACEAE: Cinnamomum uerum Prest	Dalchini, Tamal- patra.	Sem., Ec.

	Botanical name	Local name	Remarks		
125.	<i>Persea</i> sp	Gulam, Pulas	Ev.		
126.	THYMELAEACEAE: Gnidia glauca (Fres.) Gilg	Rametha	MD.		
127.	ELAEAGNACEAE: Elaeagnus conferta Roxb	Ambosni, Ambgul	MD., Ec.		
128. 129.		Chikni	3.5		
130.		Chandwad	MD.		
131.	Mallatus philippensis (Lamk.)	Kunku, Shendri	MD.		
132.	MuellArg. Sapium insigne (Royle) Benth. var. malabaricum (W.t.) Ho		D.		
133.	ULMACEAE: Celtis cinnamomea Lindl. ex planch.	la	Sem.		
137. 138.	A. incisa Linn. f		D. MD. C.		
140.	GNETACEAE: Gnetumula Brongn	Umbli	Sem.		
141.	ORCHIDACEAE: Dendrobium barbatum Lindl.	नयते	Med.		
142.	COSTACEAE: Costus speciosus (Koen.) Sm.	Kosht-Kolajan	MD., Med.		
143.	DIOSCOREACEAE: Dioscorea oppositifolia L		MD.		
144.	SMILACACEAE: Smilax zeylanica L	Ghotvel	MD., Med.		
145.	ARECACEAE: Caryota urens L	••	MD., Med.		
146.	ARACEAE: Pothos Scandens L	Kanel	MD.		
1.8. References					

1.8. References

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2. FLORA OF SANGLI DISTRICT

Sangli is a small district lying mainly in the basin of the river Krishna and some smaller ones like Yerla, Varna and others. It has eight talukas of which Shirala taluka and to some extent Atpadi are hilly, and the rest are plain. There is thick jungle at Petlond beyond Shirala. Sangli itself is on the bank of the river Krishna. The greater part of the district lies in plains.

There is post-climax vegetation on the river alluvium of Krishna and others. There is intensive cultivation of the strip type as in Egypt on the Nile. It is practised on the rich yearly deposit of alluvium, the so-called "Malies" where maize, vegetables, and jowar are often cultivated.

The more important places for plant collection lie to the west of Sangli at places like Petlond beyond Shirala. Plants of this place were collected by Profs. S. D. Mahajan and P. B. Vaidya and their list is given here. It will be seen that vegetation here is similar to that of Mahabaleshwar, semi-evergreen or even evergreen vegetation occurring in patches. In the rest of the district, there is only thorny scrub.

In Sangli proper many exotic plants have been cultivated in what is now the Municipal Garden. A number of plants, herbs, shrubs and trees grow on Krishna river banks at Sangli, Jaysingpur and Ankali. Anthocephalus kadamba is common at Ankali and an uncommon species of Equisetum, Equisetum ramosissimum grows here. The list of common plants at these places was prepared by prof. Y. G. Kate which is given here.

No authentic flora of the district is published and references to plants of Sangli in Cooke's 'Flora of the Bombay Presidency' are few. Flora of Koynanagar is unknown.

2.1. Plants found around Sangli and Jaysingpur:

Papaverceae:

Argemone mexicana Linn.

Malvaceae:

Sida rhomboidea

Bombacacea

Bombax ceiba Linn.

Oxalidacae

Oxalis corniculata. Linn.

Rutaceae:

Murraya koenigii Linn.

Meliaceae:

Azadirachta indica Linn.

Rhamnacae:

Zizyphus mauritina

Anacardiaceae:

Mangifera indica Linn.

Moringaceae:

Moringa oleifera L.

Fabaceae:

Butea monosperma (Lam) Taub.. Erythina stricta Roxb. Pongamia pinnata L.

Caesalpiniaceae:

Cassia auriculata Linn. C. fistula Linn. C. tora Linn.

Mimosaceae:

Acacia nilotica (Linn) Diels Parkinsonia aculeata L: Prosopis juliflora De.

Myrtaceae:

Syzygium cumini (L.) Skeels:

Cactaceae

Opuntia dilleniblaw

Apiaceae

Centella asitica L.

Asteraceae:

Blumea oxyodnnta Dc.
Parthenium hysterophorus
Tridax procumbens Linn.

Plumbaginaceae:

Plumbago zeylanica

Apocynacene;

Carissa congesta Wt. Nerium indicum Mill Thevetia peruviana Sch. Cuscuta reflexa Roxb.

Solanaceae:

Solannum indicum Linn. Withania somniferum Dunal

Acanthaceae:

Adhatoda vesica Nees

Verbenaceae:

Clerodendrum inerme Gaertn Duranta rapens Linn. Lantana camara var. lenleata Mold. Vitex neggndo Linn.

Lamiaceae:

Leucas aspera Spr.

Nyctaginaceae:

Boerhaavia diffusa Linn.

Amarantacene:

Achyrnthe: aspera Linn.

Euphorpiaceae:

Phyllanthus emblica Linn.
Euphorbia hirta Linn.
E. tirucalli Linn.
Phyllanthus niruri Linn.
Chrozophora prostrata Dllr.

Moraceae:

Ficus racemosa Linn. F. religiosa Linn. F. benghalenais

Casuarinaceae:

Casuarina equisetifolia Linn.

Agavaceae:

Agave americana Linn.

Pontederiaceae:

Eichornia crassipes Solm.

Cyperaceae:

Cyperus scariosus R. Br.

Poaceae:

Cynodon dactylon Pers.

2.2. Flora and Vegetation of Petlond:

This is a small village about 50 miles west of Islampur. Its altitude is about 920 m above M. S. L. It lies on a ridge surrounded by major off-shoots of Sahyadri ranges. Its highest peak close to Petlond is about

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1010 m high. It is a flat tableland. It is full of perennial and temporary streams and has a river. The rocks are of trap origin. The soil is lateritic and gravelly, reddish, brown in colour. It is not very deep, as the soil from the top is generally washed away. The average annual rainfall is 5461 mm. from June to September. July is the rainiest. During monsoons humidity is 90-100 per cent, but otherwise much less. Even then there are no trees because of high rainfall and the top soil being poor. It does not sustain rich vegetation as at Khandala. In the valleys it consists of evergreen as well as moist deciduous species. The evergreen forests are surrounded by patches of mixed vegetation, often dense. Some evergreen pockets represent climatic climax in this area. The trees and shrubs are interminged with lianas, climbers. Epiphytes, ferns, orchids, aroids, mosses, liveworts and Lichens are abundant. Dense evergreen patches do not encourage any undergrowth. Fungi on soil are plentiful. The following are the important dominant plants of this place.

The vegetation here is similar to that at Khandala and that is largely due to similar geographical situation and heavy rainfall.

Vegetation of Fetlond

Ranunculaceae:

Clematis triloba Heyne.

C. gouriana Roxb.

C. wightiana Wall.

Dilleniaceae:

Dillenia pentagyna Roxb.

Menispermaceae:

Cocculus macrocarpus Wight.
Cyclea burmanni Miers (Bl.) Diels

Cruciferae:

Cardamine subumbellata Hook.

Capparidaceae:

Capparis pedunculosa var. longispina Hook and Thoms.

Bixaceae:

Flacourtia latifolia T. Cooke.

Guttiferae:

Garcinia xanthochymus Hook.

Ancistrocladaceae:

Ancistrocladus heyneanus Wall.

Malvaceae:

Sida cordifolia Linn.

Hibiscus furcatus Willd.

Bombax malabaricum DC.

= Salmalia malabarica (DC.) Schoot and End.

Tiliaceae:

Grewia tiliaefolia Vahl.

G. microcos Linn.

=Microcos paniculata Linn.

Linaceae:

Linum mysorens Heyne

Rutaceae:

Glycomis pentaphylla Corr. Murraya koeningii Spreng. Luvunga eleutherandra Dalz. Atalantia racemosa Wight and Arn.

Olacaceae:

Mappia foetida Miers

Celastraceae:

Celastrus paniculata Willd. Gumnosporia rothiana Laws. Montana Benth.

Rhamnaceae:

Zizyphus rugosa Lamk. Scutia indica (Burm.) Kura

Vitaceae:

Leea sambucina Willd. =L. Indica (Burm.) Merr.

Sapindaceae:

Hemigyrosa canescens Thwaites Allophylus cobbe Blume

Anacardiaceae:

Odina woodier Roxb. Holigarha grahami Hook.

Leguminosae (Fabaceae):

Papilionaceae:

Crotolaria verrucosa Linn.
Indigofera pulchella Roxb.
Geissapis cristata Wight
Smithia blanda, var. racemosa Baker
S. hirsuta Dalz.
Desmodium laxiflorum DC.
D. triquetrum DC.
Erythrina indica Lamk.
Vigna capensis Walp.
Atylosia lineata Wight
Flemingia strobilifera R. Br.

= Moghania strobilifera (Linn) Jacks.
Dalbergia latifolia Roxb.

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Caesalpinaceae:

Wagatea spicata Dalz. Cassia tora L. Bauhinia malabarica Roxb.

Mimosaceae:

Acacia intsia Willd.

A. pennata Willd.

Albizzia procera Benta.

Rhizophoraceae:

Carallia integerrima DC. =C. brachiata (Lour.) Merr.

Combretaceae:

Terminalia bellerica Roxb.
T. chebula Retz.
T. tomentosa Wight.
Anogeissus latifolia Wall.
Combretum extensum Roxb.

Myrtaceae:

Eugenia hemispherica Wight Syzygium cumini Linn. Eugenia heyniana Duthie

Melastomaceae:

Memecylon umbellatum Burm.

Lythraceae:

Ammannia floribunda C. B. Clarke A. baccifera Linn. Woodfordia floribunde Salisb. Lagerstoremia lanceolata Wall.

Umbelliferae:

Pimpinella monoica Dalz, P. adscendense Dalz.

Rubiaceae:

Anthocephalus indicus A. Rich, Mitragyna parvifolia Korth, Wenlandia notoniana Wall, Randia dumetourm Lamk, Ixora nigricans Br. Ixora brachiata Roxb. Ixora parviflora Vahl.

—I. arborea Roxb, ex. Sm. Pavetta indica Linn, Rubia cordifolia Linn.

Compositae:

Vernonia cinerea L.
V. indica C. B. Clarke.
Elephantopus scaber Linn.
Conyza stricta Willd.
Blumwa membranacea DC.
B. oxyodonta DC.
Sphaeranthus indicus Linn.
Artemisia vulgaris Linn.
Senecio edgeworthii Hook.
S. grahami Hook.
Tricholepis amplexicaulis C. B. Clarke.
Flaveria contragerba Pers.

Myrsinaceae:

Maesa indica Wall. E elia viridiflora Schlett.

Sapotaceae:

Sideroxylon tomentosum Roxb.

Ebenaceae:

Maba nigrescens Dalz. Diospyros melanoxylon Roxb.

Styraceceae:

Symplocos beddomei C. B. Clarke

Oleaceae:

Jasminum malabaricum Wight Olea dioica Roxb.

Apocynaceae:

Carissa congesta Linn. Wrightia tomentosa Roem.

Asclepiadaceae:

Gymnema sylvestris R. Br. Marsdenia volubilis T. Cooke. Hoya wightii Hook.

Gentianaceae:

Canscora diffusa R. Br. Swertia decussata

Boraginaceae:

Cynoglossum denticulatum var. zeylania C. B. Clarke

Convolvulaceae:

Argyreia hookeri C. B. Clarke A, involucrata C. B. Clarke

Acanthaceae:

Strobilanthes callosus Nees:
S. ixiocephalus Benth.
Haplanthus verticillaris Nees
Lepidagathis cuspidata Nees
Eccobium linneanum Kntz

Verbenaceae:

Lantana indica Roxb.
Callicarpa lanata Linn.
Tectona grandis Linn.
Clerodendron scrratum Spreng.
C. infortunatum Linn.
= C. viscosum Vent.

Labiatae:

Plectranthus stocksii Hook.
P. incanus Link.
=P. mollis (Ait). Spreng.
Pogoste mon purpurascens Dalz.
Dysophylla stellata Benth.
Colebrookea oppositifolia Sm.
Anisomeles ovata R. Br.
Leucas ciliata Benth.

Polygonaceae:

Polygonum plebejum R. Br.

P. chinense Linn. var. ovatifolia Meissn.

Piperaceae:

Piper nigrum Linn.

P. hookeri Miq.

Lauraceae:

Cinnamomum zeylanicum Blume Actinodaphne hookeri Meissn. Litsea zeylanica Nees

Elaeagnaceae:

Elaeagnus latifolia Linn.

Loranthaceae:

Loranthus cuneatus Heyne

=Taxillus cuneatus (Roth.) Danser

L. longiflorus Desr.

= Dendrophte falcata Linn. (f). Etting.

Viscum articulatum Burm.

=V. nepalense Spreng.

V. angulatum.

Euphorbiaceae:

Euphorbia rothiana Spreng.

Bridelia retusa Spreng.

B. hamiltoniana Wall,

Glochidion hohenackeri Bedd.

Phyllanthus reticulatus Poir.

=Kirganelia reticulata (Poir) Baill.

Mallotus phillippensis Muell.

Macaranga peltata Roxb.

Urticaceae:

Ficus retusa Linn.

F. arnottiana L.

F. tsiela L.

F. glomerata Roxb.

Salicaceae:

Salix tetrasperma Roxb.

Orchidaceae:

Oberonia recurva Lindl.

Dendrobium microbolbon A. Rich,

D. barbatulum Lindl.

Eria dalzelli Lindl.

Aerides maculesum Lindl.

A. crispum Lindl.

Musaceae:

Musa superba Roxb.

Liliaceae:

Smilax macrophylla Roxb.

Paimae:

Phoenix sylvestris L. Caryota urens L.

Pandanaceae:

Pandanus farcatus Roxb.

Typhaceae:

Typha angustata Bosy.

Cyperaceae:

Cyperus pumilus Linn.

C. compressus L.

C. iria L.

C. nutans Vahl.

Kyllinga triceps Rottb.

Fimbristylis ae stivalis Vahl.

F. digitata Boeek.

Carex mercarensis Hochst var. major stor

Gramineae:

Setaria glauca Beauv.
Digitaria sanguinalis Scop.
var. ciliaris Prain
D. royleana Prain
Paspalum compactum Roth.
Apluda varia Hook.
Ischae mum laxum Br.
Themeda imberbis T. Cooke
T. triandra Hook.
Iseilema wightii Anders.
Arundinella tenella Nees and Wight
Eragrostis amabilis Wt. and Arn.
Bambusa arundinacea Willd.
Dendrocalamus strictus Nees

3. FLORA OF SATARA DISTRICT

Satara is a hilly district drained by Krishna, Koyna, Iravati and other rivers flowing through Krishna basin. These rivers rise from Mahabale-shwar which is the second highest peak of Sahyadri, 1438 m. in height. It lies at the west edge of the Sahyadri mountains. It gets about 6226 mm. of rain and has evergreen vegetation on Konkan side and semi-evergreen forests on Desh side. Further east the vegetation consists of dry deciduous forests. Panchgani is another place rich in variety of flora. Though only 20 kilometres east of Mahabaleshwar it gets only 2285 mm. rain. The third important place for flora is Koynanagar, near Helvak standing at the edge of the ghats on west side of the village Helvak, where there is virgin forest. The flora of Koynanagar area and Koyna valley has not been worked out. A check list of plants of Koyna area is given here mainly on the basis of plants collected by Dr. S. D. Patil.

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On the other hand, the flora of Mahabaleshwar and Panchgani is fairly well-known. It also needs revision. Dr. Razi has given an account of Panchgani plants after Blatter's in 1908 or Birdwood's (1896) account of Mahabaleshwar plants, there being no systematic account of the flora of both these places. Both the places lie in high hilly region of Sahyadris. Recently, Prof. P. V. Bole has been revising plants of Mahabaleshwar in Bombay Natural History Society's Journal.

Besides these, the plants of Kas area near Satara have been explored by Dr. P. B. Chavan and his associates (1973). Their list and account of the flora of Kas area are given here. In all these areas the ratio of wet to dry season is 3: 9. Naturally, the vegetation is mostly of the deciduous type—dry or moist. In between at high altitude, there are pockets of evergreen vegetation in deep ravines at high elevation.

Soil erosion is very conspicuous either due to heavy rainfall, temperature or winds. This results in lateritic soils getting washed away, progressively gathering at the lower levels. They get leached and become deficient in calcium, potasium and phosphorus. But in the valleys on Desh side, the forest leaf litter gets mixed with soils and soils become fertile. At places practically all the top soil is washed away and hard basalt is exposed on the westerly hills around Satara, Panchgani etc. The Kas area near Satara has improved in complexion because of the artificial bund constructed there. The following pages give a sketch of the flora of important places in Satara district.

3.1. Flora of Kas area near Satara.

Kas (17 ° 40′ N and 73 ° 56′ E) is near Satara town on a spur of Sahyadri 1310 m. high. The bund here was constructed in 1886. It produced a lake supplying potable water to Satara. The climate of the area is temperate. The rainfall is between 381—457 cm., mostly between June to October.

Soil like the soils at other places in Satara district is red being of lateritic origin. Its PH varies from 6 to 6.5. The area is well protected from winds by surrounding hills but vegetation is much destroyed by biotic factors, especially man and forest fires. Porcupines add to the destruction of vegetation. References to flora of Satara district are found in Hooker (1812—1897), Nairne (1894), Cooke (1908), Vartak (1956), besides stray references in some others. Chavan and others (1973) have described 128 angiosperm species belonging to 116 genera of 54 families, and added later 84 species and 16 more families. The vegetation is either moist deciduous or in parts, mixed or dry deciduous. This becomes apparent from the subjoined list of plants, which can be compared with that of Panchgani.

On the whole, it may be said that the flora of Satara district is much varied and rich. It is typical of the regions adjoining Sahyadris.

Flora of Kas area

(after P. B. Chavan, V. P. Khandekar, S. H. Mahamulk, 1973.)

Ranunculaceae Habitat Clematis gouriana Roxb. Roadside

Menispermaceae:

Stephania japonica (Thunb) Miers .. Roadside

Brassicaceae (Cruciferae):

Cardmaine trichocarpa Hochst

Flacourtia ceae:
Flacourtia indica Merr.
F. latifolia Cooke

Polygalaceae: Polygala persicariaefolia D. C. .. On way to Kas Malvaceae: Urena lobata Linn. Oxalidaceae: Biophyturn sensitivum (Linn.) D.C. Open land Moist places Oxalis corniculata Linn. Balsaminaceae: Impatiens balasamina Linn, var rosea Hack. I. lawii Hack. Rutaceae: Evodia lunu-ankenda Gaetn.: Icacinaceae: Nothopodytes foetida Schum. Celastraceae: Maytenius rothiana Rhamnaceae: Scutia circumscissa Druce Zizyphus rugosa Lamk Vitaceae: Cayratia elangata Edges of Forests Sapindaceae: Allophylus serratus (Roxb) Radik Anacardiaceae: Mangifera indica Linn. Fabaceae: Alysicarpus tetragonolobus Edge. Atylosia lineata Wt. and Arn. Crotolaria retusa Linn. Desmodium rotundifolium Bak. Goniogyna hirta (Willdi)Ali On rocks Indigofera dalzelli Cooke ... I. cassioides, Moghania nilgherriensis M. strobilifera (Linn.) St. Hil, ex. Jacks Amongst grasses in rainy Smithia bigemina Dalz. season. Vigna radiata In grasses V. ratiata var. sublobata V. vexillata Rich. Caesalpiniaceae: Cassia fistula Linn. Droserceae: Drosera indica Linn. In grasses near bund. D. burmannni Vahl. By lake side. Combretaceae: Combretun ovalifolium Roxb.

Terminalia chebula Retz.

Myrtaceae:

Syzygium cumini (Linn) Skeels

Melastomataceae:

Memecylon umbellatum Burm.

Lythraceae:

Rotala densiflora (Roth) Koehne Woodfordia fruticosa Salisb

.. Road to Yawteshwar

Cucurbitaceae:

Dicoelospermum ritchiei C. B. Clarke Mukia madersparana Trichosanthes bracteata (Lamk) Voigt

Begoniaceae:

Begonia crenata Dryand

Aizoaceae (Molluginaceae) Glinus lotoides Linn.

Apiaeae (Umbelliferae)

Centella asiatica (Linn.) Urb Heracleum concanense Dalz, Pimpinella sp.

Rubiaceae:

Canthium dicocum var. umbellatum Gamble Meyna laxiflora Robyns
Neanotis foetida (Benth. and Hook. f.) Lewis Oldenlandia corymbosa Linn.
Hedyotis corymbosa
Oldenlandia sp.
Pavetta crassicaulis Bremk.
Psychotria truncata Wall.
Rubia cordifolia Linn.
Wendlandia thyrsoidea R. and S.
Xeromphis spinosa (Thunb) Keay

Asteraceae:

Artemisia sp.
Blumea laura DC.
Caesulia axillaris Roaxb.
Eclipta prostrata (Linn) L.
Senceio grahami Hook. f.
Sphaeranthus indicus Linn.

Campanulaceae:

Wahlenbergia peduncularis Schrad.

Lobeliaceae:

Lobelia nicotianaefolia Heyne

Plumbaginaceae:

Plumbago zeylanica Linn.

Sapotaceae:

Zantolis tomentosa (Roxb) Ref.

Oleaceae:

Jasminum malabaricum Wight Olea dioica Roxb.

Apocynaceae:

Carissa congesta Wt.

Rauwolflia serpentina (Linn) Benth ex. Kurz

Asclepiadaceae:

Asclepias curasavica Linn.

Calotropis gigantea (Linn) R. Br.

Ceropegia bulbosa Roxb.

C. oculata var. oculata Hook.

Cryptolepis buchanani R. and S.

Dragea volubilis (Linn. f.) Benth. ex. Hook f.

Gymnema sylvestre (Retz.) Schult.

Hemidesmus indicus Schult,

Open land.

Leptadenia reticulata Wt. and Arn.

Pergularia daemia (Forsk.) Blatt.

Gentianaceae:

Canscora diffusa R. Br.

Exacum bicolor Roxb.

E. lawii Clarke

Nymphoides indicum (Linn) O. Kuntze

Boraginaceae:

Adelocaryum coelestinum (Lindl.) Brand

Cordia dichotoma Forst. f.

Trichodesma amplexicaule Roth

Convolvulaceae:

Argyreia cuneata Ker-Gawl. Evolvulus alsinoides Linn.

Solanaceae:

Solanum indicum Linn.

Scrophulariaceae:

Limnophila indica (Linn) Druce.

Ramphicarpa longiflora (Arn.) Benth.

Striga densiflora Benth.

S. gesmeroides (Willd.) Vatke

Lentibulariaceae:

Utricularia reticulata Sm.

U. striatula Sm.

Utricularia sp.

Thunbergiaceae:

Thunbergia lae vis Necs

Acanthaceae:

Adhatoda vasica Nees

Asystasia dalzelliana Sant.

Blepharis asperrima Nees

Carvia callosa (Nees) Bramek. Eranthemum roseum (Vahl) R. Br.

Haplanthus neilgherryensis Wt.

Hygrophila auriculata (Schum) Heyne

Justicia simplex Linn.

Lepidagathis cristata Willd.

L. cuspidata Nees

Acanthaceae-cont.

Peristrophe bicalyculata (Retz.) Nees. Pleocaulus ritchiei (Clarke) Brem.

Rungia repens (Linn) Nees

Verbenaceae:

Clerodendrum serratum (Linn) Morn.

Labiaceae:

Colebrookia oppositifolia Sm. Dysophylla stellata Benth. Lavandula burmanni Benth. Leucas biflora R. Br. L. stelligera Wall ex Benth. Plectranthus stocksii Hill Pogostemon parviflorus Benth.

Amaranthaceae:

Achyranthes aspera Linn. Allmania nodiflora R. Br. Alternanthera sessilis (Linn)

Polygonaceae:

Polygonum chinense Linn. var ovalifolia

Meissn.

P. glabrum Willd.

P. plebejum R. Br.

Lauraceae:

Actinodaphne angustifolia Nees Litsea stocksii Hook.

Thymeliaceae:

Lasiosiphon eriocephalus Decne.

Elaeagnaceae:

Elaeagnus conferta Roxb.

Loranthaceae:

Viscum angulatum Heyne

Santalaceae:

Osyris wightiana Wall ex. Wt.

Balanophoraceae:

Balanophora indica Wall. On

On roots of Syzygium cumini.

Euphorbiaceae:

Bridelia retusa (Dennst.) Alston

B. squamosa Greham

Euphorbia antiqorum Linn.

E. acaulis Linn.

E. hitra Linn.

E. rothiana Spreng.

Glochidion hohenackeri Bedd.

Phyllanthus asperulatus Hutch.

P. reticulata Poir Baill.

Securinega leucopyrus (Willd.) M. Arg. Tragia muelleriana var unicolor (M. Arg.)

P. and H.

Urticaceae:

Debregeasia longifolia (Burm) Wedd.

Giraldinia zeylanica Decne.

Lecanthus peduncularis (Wall.) Wedd.

Pouzolzia pentandra Benn.

Moraceae:

Artocarpus heterophyllus Lamk.

Salicaceae:

Salix tetrasperma Roxb.

MONOCOTS

Orchidaceae:

Aerides crispum Lindl.

Dendrobium barbatulum Lindl. On Xeromphis spinosa.

D. malebae Gammie

D. mierobulbon Rich.

Habenaria crassifolia A. Rich.

H. gibsoni Hook, f.

H. grandifloriformis Blatt and M. C.

H. hevneana Lindl.

Malaxis versicolor Lindl.

Oberonia recurva Lindl.

Zingiberaceae:

Curcuma pseudomontana Grah.

Zingiber cernuum Dalz.

Z. zerumbe t Foscoe.

Hypoxidaceae:

Curculigo orchioides Gaertn.

Hypoxis aurea Lour.

Amaryllidaceae:

Crinum brachynema Herbert.

Dioscoreaceae:

Dioscorea pentaphylla Linn.

Liliaceae:

Asparagus racemosus Willd, var. javanica

Baker.

Chlorophytum laxum R. Br.

Gloriosa superba Linn. Way to Kas

Dipcadi montanum Dalz.

Iphigenia indica (Linn) A Gray.

Scilla hyacinthiana (Roth) Mcbride.

Smilacaceae:

Smilax zeylanica Linn.

Commelinaceae:

Commelina diffusa Burm. f.

Cyanotis tuberosa Roxb. Sehult, f.

Murdannia semeteres Sant.

M. versicolor (Dalz.) Bruckn.

M. virgata (Linn) Bruckn.

Pandanaceae:

Pandanus furcatus Roxb.

A-127-38-A.

Araceae:

Arisaema murrayi (Grah.) Hook, A. neglectum Schott.

Eriocaulaceae:

Eriocaulon sp.

Cvperaceae:

Cyperus liria Linn. C. malabaricus (Clarke) Cooke C. triceps (Rottb.) Endl.

Poaceae:

Andropo gon pumilus Roxb. Arundinella metzii Ho ckst et Mig. Aristida adscensienis Linn. Brachiaria reptans Linn. Chrysopogon montanus Linn. Cynodon dactylon Linn. Ergarostis pilosa (Linn.) Beauv. E. tenuifolia Hock tt. ex Steud. E. unioloides (Retz) Nees ex. Steud. Heteropogon contortius (Linn) Beauv. Jansenella griffithiana (C. Muell) Bor. Oplismenus compositus (Linn) Beauv. Paspalidium flavidum (Retz) A. Camus Paspalum scrobiculatum Linn. Setaria glauca (Linn.) Beauv. S. tomentosa (Roxb.) Kunth Thelepogon elegans Roth Themeda arundinacea Ridley

3.2. Flora and Vegetation of Panchgani:

Panchgani is a well-known hill station in Satara District. It lies 12.8 km away from Wai and about 20 km from Mahabaleshwar. Its altitude at the Tableland is 4378 feat. The town of Panchgani is at 4300'. It is less than Mahabaleshwar, but the difference between Mahabaleshwar and Panchgani is tremendous. Mahabaleshwar gets 6226.3 mm of rains, but Panchgani gets about 2285 mm of rain as it lies in rain shadow. Its temperature ranges from 56-100 °F. It has generally about 71° F mean temperature at noon. Geologically it stands on volcanic rocks, the Deccan traps. The soil on the top hills is reddish lateritic. But it is not deep. Laterite is of porous argillaceous type. It gets saturated with water in rainy season but hardly retains it due to iron peroxide in it. The various regions of Panchgani are characterised by particular species. Gravillea robusta is grown all over except on Tableland, making Panchgani look like an Alpine town.

The most significant feature of Panchgani is tableland. This is reached by a zig-zag path from town. Many Papilionaceous plants like Smithia hirsuta, Eriocaulon species grow here and there. There are two small lakes which have Dysophylla stellata var. gracilis and carpets of Utricularia. At a little lower altitude Aneilema, Alysicarpus belgaumensis are common. In the rainy season the tableland is full of monsoon ephemerals e.g. species of Habenaria, Striga, Dipcadi montanum etc., Isoetes dixitii is found in the lake on tableland but very often the plants get dried by about October. Below the tableland, several ferns and

shrubs of Lasiosiphon eriocephalus, Pogostemon parviflorus occur. Ferns like Nephrolepis, Athyrium are common, besides many other plants.

The flora of Panchgani was worked out by Father Blatter (1908) in a paper published in *Journal of Bombay Natural History Society* [19(2)]: 314-332. He enumerated 367 plants belonging to 89 families and 11 ferns.

After this the plants of this place were restudied by Dr. B. A. Razi (1952). His list contains many new species and 'grasses which are worthy of note. Since Razi's list is more recent than that of Blatter it is given here. It also includes all Blatter's species besides those added recently.

A remarkable thing of Panchgani plants is that many plants found at Mahabaleshwar are also found here, but they do not form dense vegetation. Even a conifer like *Pinu's longifolia* grows here in a private bungalow (*Dil Pazir*) at the foot of the tableland. There are many weeds like *Oenothera rosea*. Coffea arabica grows well. They are introduced or are escape from garden. Panchgani is dry for 7 months and humid for 5 months.

Plants of Panchgani (after Razi, 1952)

Ranunculaceae:

Clematis gouriana Roxb. C. triloba Heyne

Magnoliaceae:

Michelia champaca L.

Anonaceae:

Artabotrys odoratissima R. Br.

Menispermaceae:

Diploclisia glaucescens (Bl.) Diels
Cocculus hirsutus (L.) Diels
= C. villosus D. C.
Stephania hernandifolia Walp.

Cyclea burmanni (D. C.) Hook f. and Th.

Papavaraceae:

Argemone mexicana L.

Capparidaceae:

Nasturtium officinale R. Br. N. subumbellata Hook f.

Pittosporaceae:

Pittosporum floribundum W. and A.

Caryophyllaceae: Stellaria media Cyril

Saponaria vaccaria L.

Portulacaceae:

Portulaca obraceae L.

=Talinum cuneifolium Willd.

Malvaceae:

Abutilon polyandrum W. and A. Sida acuta Burm.

S. rhombifolia L.

Urena sinuata L. Kvdia calvcina Roxb. Thespesia populnea L.

Tiliaceae:

Grewia microcos L. G. tiliaefolia Vahl. Triumfetta pilosa Roth. T. rhomboidea Jacq. Erinocarpus nimmoniannus Grah.

Elaeocarpus:

Elaeocarpus oblongus Gaertn.

Linaceae:

Linum mysorense Heyne Reinwardtia trigyna Planch ex. Hook.

Rutaceae:

Evodia roxburghiana Benth. Glycosmis pentaphylla Correa Murraya exotica L. M. koenigii Spr. Atalantia manophylla DC.

Burseraceae:

Garuga pinnata Roxb.

Meliaceae:

Soymida febrifuga Juss. Cedrela toona Roxb.

Malpighiaceae:

Hiptage bengalensis (Linn.) Kura. Gymnosporia montana (Roxb.) Benth.

Rhamnaceae:

सन्द्राम्ब जयन Scutia indica Brongn. Zizyphus rugosa Lamk.

Balsaminaceae:

Impatiens acaulis Hook.

1. balsamina Linn. var, agrestis Hook f.

I. delzellii Hook f.

I. inconspicua Benth var. ramosssima Bl.

I. pulcherrima Dalz.

Sapindaceae:

Allophylus cobbe Bl.

Anacardiaceae:

Mangifera indica L.

Leguminosae:

Sub-family: Mimosoideae Mimosa pudica L. Acacia intsia (Linn.) Willd. Albizzia amara Boivin. A. lebbek Benth. A. stipulata Boivin. Grona dalzelli Baker

Sub-tamuy Caesalpiniodeae:

Wagateu spicata Dalz.
Cassia fistula Linn.
Bauhinia racemosa Lamk.
Sub-family: Papilionaceae
Desmodium triflorum DC.
Vigna capensis Walp.
Atylosia lineata W. and A.
Cylista scariosa Roxb.
Dalbergia lanceolaris Linn
D. latifolia Roxb.
Pongamia glabra Benth.

Rosaceae:

Fragaria vesca L.
Prunus persica Stocks.
Pyrus malus L.
Rosa multiflora Thunb.
Rubus lanciocarpus Sm.

Crassulaceae:

Bryophyllum pinnatum (Limk.) Kurz (=B. calycinum Salisb.) Kolanchee spathulata DC,

Combretaceae:

Anogeisus latifolia Wall. Calycopteris floribunda Lamk. Eugenia jambolana Lam. (=Eugenia heyneana Duthie)

Melastomaceae:

Memecylon umbellatum Burm.

Lythraceae:

Ammannia floribunda Clarke A. pentandra Roxb. Lagerstroemia indica L. L. parviflora Roxb.

Cucurbitaceae:

Trichosanthes palmata Roxb.
Cucumis melo L.
Melothria heterophylla Cogn.
M. leiosperma Cogn.
M. maderaspatana Cogn.
M. perpusilla Cogn.

Begoniaceae:

Begonia crenata Dryand.

Umbelliferae:

Carum stictocarpum Clarke Pimpinella adscendens Dalz. P. candollena W. and A. P. monoica Dalz. P. tomentosa Dalz. Heracleum concanicum Dalz.

Rubiaceae:

Mitragyna parvifolia Korth, Wendlandia notoniana Wall,

Odlenlandia corymbosa L.
Anotis lancifolia Hook f.
Pletronia wightii Cooke
Meynia laxiflora Robyns
Xeromphi, spinosa
(=Vangueria spinosa Auct.)
Ixora nigricans Br.
I. parviflora Vahl.
Pavetta indica L.
Coffea arabica L.
Hamiltonia suaveolens Roxb.
Rubia cordifolia L.

Campanulaceae:

Cephalostigma schimperi Hochst Lobelia trigona Roxb.

Compositae:

Centratherum phyllolaenum (DC) Benth. C. tenue Clarke

Adenoon indicum Dalz.
Vernonia indica Clarke
Adenostemma viscosum Forst.
Dichrocephala latifolia DC.
Conyza stricta Willd.
Bidens biternata Merr. Sherff
(=B. pilosa Auct.)
Tridax procumbens L.
Artemisia parviflora Bach-Ham.
A. vulgaris L.

Gynura angulosa DC.
Notonia grandiflora DC.
Senecio edgeworthii Hook f.
Tricholepis glaberrima DC.
Lactuca runcinata DC.

Plumbaginaceae: Plumbago zeylanica L.

Myrsinaceae:

Maesa indica Well. Embelia ribes Burm.

Sapotaceae:

Mimusops elengi L. Symplocos beddomei Clarke

Ebenaceae:

Diospyros melanoxylon Roxb.

Oleaceae:

Jasminum malbaricum Wt. Ligustrum neilgherrense Wt. Var. Obovatum Clarke.

Apocynaceae:

Carissa congesta Wt. (=C. carandas L.) Holorrhena antidysenterica Wall.

Asclepiadaceae:

Calotropis gigantea R. Br. C. hirsuta W. and A.

Gymnema sylvestre R. Br. Marsdenia volubilis T. Cooke Hoya retusa Dalz. Ceropegia hispida Blatter and McCann

Gentianaceae:

Exacum lawii Clarke C. diffusa R. Br. Swertia minor Cooke

Limnanthemum cristatum Griseb.

L. indicum Thw.

Boraginaceae:

Cynoglossum denticulatum A. DC. Var. zeylanicum Clarke Paracaryum coelestinum Benth.

P. malabaricum Clarke

Convolvulaceae:

Argyreia hookeri Clarke

Solanaceae:

Solanum giganteum Jacq. S. indicum L.

Physalis peruviana L.

Scrophulariaceae:

Verbascum coromandelianum (Vahl.) Kuntze. (=Celsia coromandeliana Vahl.) Kickxia ramosissima (Wall.) Janchen. (=Linaria ramosissima Wall.) Bonnaya veronicaefolia Spreng.

Striga gesneroides (Willd.) Vatke. (=S. orobanchoides Benth.)

Sopubia delphinifolia (Roxb.) G. Don.

Lentibulariaceae:

Utricularia caerulea L. U. striatula Sm.

Acanthaceae:

Asteracantha longifolia (Linn.) Nees

Strobilanthes callosus Nees

S. heyneanus Nees

S. ixiocephalus Benth.

S. scrobiculatus Dalz.

Haplanthus verticillaris (Roxb.) Nees

Barleria strigosa Willd. Var. terminalis Clarke

Lepidagathis cuspidata (Wall.) Nees

Rungia elegans Dalz. & Gibs.

Rungia pectinata (L.) Nees (=R. parviflora Nees var. pectinata Clarke)

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Dicliptera zeylanica Nees

Justicia betonica Linn. var. ramosissima Clarke

J. micranth Heyne

J. trinervia Vahl.

Adhatoda vasica Nees

Rhinacanthus communis Nees

Verbenaceae:

Lantana camara Linn. var. aculeata Moldenke

Callicarpa lanata L.

Clerodendrum serrulatum Spreng.

Labiatae:

Plectranthus mollis (Ait) Spr. (=P. incanus Link. P. stocksii Hook f.)

Lavandula perrottetii Benth (=L. gibsoni Grah.)

Pogostemon parviflorus Benth.

Dysophylla stellata Benth.

Colebrookea oppositifolia Sm.

Micromeria capitata Benth.

Anisomeles heyneana Benth.

Leucas ciliata Benth.

Nepeta hindustana (Roth) Haines

(=N. ruderalis Buch-Ham.)

N. hindustana (Roth) Haines var. woodrowii

Salvia plebeja R. Br.

Nyctaginaceae:

Boerhaavia diffusa L. (-B. repens L).

Amarantaceae:

Celosia argentea L.

Achyranthes aspera L.

Aerua lanata Juss.

Alternanthera sessilis (L.) R. Br.

Chenopodiaceae:

Chenopodium ambrosioides L.

Polygonoceae:

Polygonum elatum Buch. Ham.

P. chinense L. var. ovalifolium Meissn.

P. glabrum Willd.

P. plebejum R. Br.

Piperaceae:

Piper hookeri Mig.

Lauraceae:

Litsea stocksii Hook f.

L. tomentosa Heyne

Actinodaphne hookeri Meissn,

Euphorbiaceae:

Èuphorbia acaulis Roxb.

E. hirta L. (=E. pilulifera L.)

Bridelia retusa Spr.

Emblica officinalis Gaertn (=Phyllanthus emblica L.)

Fluggea leucopyrus Willd.

Glochidion hohenackeri Bedd.

Chrozophora rottleri Klotzsch.

Acalypha brachystachya Hornem.

Thymelaeaceae:

Lasiosiphon eriocephalus Decne.

Eleagnaceae:

Elaeagnus conferta Roxb. (=E. latifolia L.)

Loranthaceae:

Loranthus scurrula L.

Viscum angulatum Heyne ex DC.

Urticaceae:

Girardinia zeylanica Decne.

Lecanthus pedunculris (Wall) Wedd.

(=L. wallichii Wedd.)

Moraceae:

Ficus bengalensis L.

F. carica L.

F. infectoria Roxb.

F. religiosa L.

F. retusa L.

F. tomentosa Roxb.

Morus alba L.

Salicaceae:

Salix tetrasperma Roxb.

Centrophyllaceae:

Centrophyllum demersum L.

Orchidaceae:

Dendrobium barbatulum Lindl.

D. mabelae Gammie.

Porpax lichenora Cooke.

Eria dalzellii Lindl.

E. rupestris Blatter and McCann.

Aerides maculosum Lindl.

Microstylis versicolor Lindl.

Eulophia pratensis Lindl.

Peristylus xanthochlorus Blatter and McCann.

Habenaria cerea Blatter and McCann.

H. cerea Blatter and McCann Var. Polyantha Blatter and McCann.

H. crassifolia A. Rich.

H. digitata Lindl.

H. grandifloriformis Blatter and McCann.

H. grandifloriformis Blatter and McCann Var. acquloba Blatter and McCann.

H. heyneana Lindl.

H. rariflora A. Rich.

H. rariflora A. Rich var. latifolia Blatter McCann.

H. suaveolens Dalz.

H. variabilis Blatter and McCann.

Musaceae:

Ensete superbum (Roxb.) Cheeseman.

(=Musa superba Roxb.)

Zingiberaceae:

Hedychium coronarium Koenig.

Hitchenia caulina Baker.

Amaryllidaceae:

Crinum latifolium L.

Curculigo orchioides Gaertn.

Liliaceae:

Asparagus racemosus L. var. javanica Baker.

Smilax macrophylla Roxb.

Chlrophytum orchidastrum Lindl.

Commelinaceae:

Commelina nudiflora L.

Aneilema sinicum Lindl.

A. spiratum R. Br.

Cyanotis axillaris Schult. f.

C. cristata Schult. f.

C. fasciculata Schult. f.

C. fasciculata Schult. Var. f. glabrescens Clarke.

Palmae:

Caryota urens L.

Araceae:

Acorus calamus L.

Typhonium amboinense (Rumph) Blatter and McCann (=:Arisarum amboinense Runpn.)

Ariopsis peltata Nimmo.

Remusatia vivipara Schott.

Arisaema langecaudatum Blatter.

A. murrayi (Grah.) Hook.

Sauromatum guttatum (Wall.) Schott.

Cyperaceae,:

Kyllinga brevifolia Rottb.

K. melanosperma Nees.

K. triceps Rottb.

Pycreus capillairs Nees.

P. latespicatus Clarke.

P. nitens Nees.

P. pumilus Bom.

P. sanguinolentus Nees.

Juncellus laevigetus Clarke.

Cyperus aristatus Rottb.

C. digitatus Roxb.

C. eleusinoides Kunth.

C. iria L.

C. macraei Clarke.

C. nutans Vahl.

C. rotundus Linn.

Miniscus paniceus Vahl.

Eleocharis fistulosa Link.

Fimbristylis annua Rsem.

F. dichotoma Vahl.

F. diphylla Vahl.

F. ferruginea Vahl.

Potamogetonaceae:

Potamogeton indicus Roxb.

Graminae:

Dimera ornithopoda Trin.

Ischaemum aristatum Linn.

I. impressum Hack.

I. laxum R. Br.

I. pilosum Hack.

Schima nervosum Stapf.

Apluda aristata Linn.

Peltophorus divergens (Hack.) Camus.

Eulalia argentea Brongn.

Arthraxon echinatus Hochst.

A. hispidus (Thunb.) Mamino.

A. inermis Hook. f.

A. meeboldii, Stapf.

A.quartinianus Nash.



A. serrulatus Hochst.

Capillipedium hugelli (Hack.) Camus.

Amphilopis pertusa Stapf.

Vetiveria zizanioides (Linn.) Nash.

(=A, squarrosus Hook. f.)

= A. muricatus Retz.)

Dichanthium annlatum Stapf.

(=Andropogon annulatus Forssk.)

D. mccannii Blatter.

D. panchganiense Blatter and McCann.

D. serrafalcoides Blatter and McCann.

Themeda cymbaria Hack.

(=Anthistiria cymbaria Roxb.)

T. quadrivalvis O. Ktze.

(=Anthistiria ciliata Linn. f.)

T. triandra Forssk.

Iseilema anthephoroides Hack.

I. laxum Hack.

I. prostratum Anders.

(= I, wightii Anders).

Eremopogon foveolatus Stapf.

(=Andropogon foveolatus Del.)

Andropogon pumilus Roxb.

Cymbopogon citratus Stapf.

(= Andropogon schoenanthus (Linn).

C. martinii Stapf.

Hackelochola granularis O. Ktze.

(=Manisuris gronularis L.)

Ophiuros exaltatus O. Ktze.

Manisuris forficulata Fischer

(=Rottboellia divergesns Hack.)

Pseudanthistiria hispida Hook. f. Digitaria marginata Link var. fimbriata Stapf.

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D. longifolia Pers.

Alloteropsis cimicina Stapf.

Brachiaria isachne Stapf.

Paspalum compactum Roth.

P. scrobiculatum L.

Echinochia colona Link.

Oryza sativa L.

Triticum vulgare L.

Bambusa arundinacea Retz.

(=B. arundo Klein)

B. valgaris Schard.

Echinochloa stagnina Beauv.

Oplismenus burmanni P. Breauv.

C. compositus Beauv.

Panicum miliaceum L.

Setaria intermedia R. and S.

S. italica Beauv.

S. pallidifusca Stapf. ex. Hubb.

S. plicata T. Cooke.

P. typhoides Stapf of Hubb.

Isachne australis R. Br.

I. elgans Dalz.

I. lisboae Hook. f.

I. miliacea Roth.

Arundinella hispida Ktze.

A. spicata Dalz. A. tenella Nees. A. tuberculata Munro. Garnotia stricta Brongn. Aristida adscencionis Linn. (=A. depressa Retz.)A. funiculata Trin. and Rupr. A, redacta Stapf. Sporobolus diander Beauv. S. piliferus Kunth. S. gangeticus Steud. Eragrostis nutans (Retz) Nees. E. tenuiflora Hochst. E. unioloides Nees. Cynodon dactylon Pers. Chloris barb 21a Swartz. Eleusine corucana Gaertn.

3.3. Mahabaleshwar Ghats and their flora:

The road goes from Wai to Mahabaleshwar along the edge of the Sahyadri ranges in a tortuous way. On the other side, it goes down via Pratapgad to Mahad by the very steep Fitzgerald ghat. The trees seen at high level are: Glycosmis mauritiana, Memecylon talbotianum, Symplocos beddomei, Ficus rumphii, Alseodaphane semecarpifolia, Litsea stocksii, Actinonodaphe angustifolia, Artocarpus heterophyllus.

Shrubs are Ligustrum perottetii, Rauwolfia densiflora, Scutia circumscissa, Wagatea spicata, Embellia ribes, Pavetta crassicaulis.

Herbs are Cardamine trichocarpa, Impatiens acaulis, Arisaema caudatum, Dichanthium panchananiense, Arthraxon raizadae, Smithia agharkarii, Blumea malcolmii, Dysophylla, salicifolia, Rotala floribunda, Arundinella spicata, Swertia densifolia, Hitchenia caulina.

At the foot of all these ghats on the Konkan side there is thick vegetation and sacred groves or "Dev Raies". From the main ranges of Sahyadris, several lateral spurs run towards Konkan, some extending right upto sea, e.g., those at the end of the ghats like Kankavali, Kudal, Malvan, Sawantwadi, Ugewa Devi, Phonda and Amboli. Various views are held about ghat flora by different authors like Hooker, Cooke, Mani and others. We hold the view that they present vertical sections of the whole vegetation of Sahyadris at different levels and are adapted to various heights in the nitches in ghats, suitable to them. There is also monsoon flora of plants such as Arissaema, Chlorophytum, and some other tuberous plants on the upland flats at different levels.

Rainfall at Mahabaleshwar:

About 80—85 per cent of annual rains are received from south-west monsoon. July is the rainiest month. The number of rainy days are 120—125 and mean humidity is always above 60 per cent. The following trees are found in Mahabaleshwar:—

Garcinia talbotii, Mammea surirega, Atalania racemosa, Aglaia elaeagniide, Dysoxylum binecteriferum, Nothopodytes foetida, Syzygium caryophyllatum, Persea macrantha, Homalium zylanicum, Xantolis tomentosa, Mapa nigrescens, Symolocas. courina, Diosoyros candolleana, D. melanoxylon, Beilschmiedia dalzellii, Celtis cinnamomea, Holigarna arnottiana, Hydnocarpus Iaurifolia, Calophyllum apetalum, Litesea deccanenis.

Shrubs are Decaschistria trilobata, Grewia ritchiei, Microcos paniculata, Murraya paniculata, Ochna squarrosa, Scutia circumscissa, Lepisanthes tetraphylla, Connarus wightii, Tuyrraea villosa, Syzygium phillyraeoides, Canthium dicoccum, Rauwofia densiflora, Salacia chinensis.

Herbs are Cardamine trichocarpa, Impatiens acaulis, Adenostemma viscosum, Nilgirianthus lupillinus, Leucas ciliata.

At the base of the ghat, in the rainy season there is marshy ground which when dried is suitable for rice cultivation. The important trees at the top of the ghat are: Hydnocarpus laurifolia, Diospyros oocarpa, Terminalia crenulata, T. bellerica, Memecylon umbellatum, on the ghat top shrubs of Ixora brachiata and herbs like Tephrosia tinctoria, Clerodendrum viscosum, Habenaria marginata, Costus specious, Gloriosa superba grow generally mixed with tall woody climbers like Entade, Acacia pennata, Anodendron paniculataum, Tylophora indica, Lygodium flexuorum. We can see Dev Raies at Amboli. These Dev Raies are peculiar conservatories of trees and they invariably contain some trees or shrubs which are not found in the vicinity.

Important Mahabaleshwar Plants:

A comprehensive list of Mahabaleshwar plants is given by Birdwood (1897). The more common plants of the plateau are given below. They have also been mentioned by Santapau (1952) in his paper on the vegetation of the place. A list prepared from it is given here. Vegetation is evergreen or some semi-evergreen in valleys and pockets. They are very rich in species.

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Important common plants on Mahabaleshwar Plateau:

Name of the species:

Ranunculaceae:

Clematis triloba Heyne ex Roth.

Cruciferae:

Capsella burspa-storis Medk,

Capparidaceae:

Capparis spinosa var. V. vulgaris Linn.

Pittosporaceae:

Pittosporum floribundum W. & A.

Polygalaceae:

Polygala perisicariaefolia DC.

Caryophylacae:

Saponaria vaccaria Linn. Stellaria media Linn. Polycarpon-loeflingiae Benth. & Hook, f.

Sterculiaceae:

Helicteres isora Linn.

Tiliaceae:

Elaeocarpus ablongus Goertn.

Linacceae:

Reinwartlia trigyna Hook.

Geraniaceae:

Impatiens acaulis Hook.

Rutaceae:

Toddalia aculeata Pres, Murraya exotica Linn. var. paniculata Jacq.

Burseraceae:

Boswellia serrata Roxb.

Meliaceae:

Cipadessa fruticosa Blume.

Olaceae:

Mappia foetida Miers. M. oblonga Miers.

Celastraceae:

Gymnosporia emarginata Roth.

Sapindaceae:

Allophyllus cobbe Blume.

Leguminosae:

Dumasia villosa DC. Atylosia lineata W. A. Pongamia glabra Vent.

Rosaceae:

Rubus lasiocarpus Smith.

Crassulaceae:

Bryophyllum calycinum Salisb.

Halorangeaceae:

Myriophyllum intermedium DC.

Melastromaceae:

Ammania floribunda Clarke A. bacciifera Linn.

Onagraceae:

Genothera rosea.

Cucurbiaceae:

Zonaria sp.

Umbelliferae:

Pimpinella tomentosa Dalz.

Rubiaceae:

Anthosephalus cadamba Miq. Oldenlandia corymbosa Linn. Anotis lancifolia Dalz.

Campanulaceae:

Lobelia trialata Buch. Ham.

Plumbagineae:

Plumbago zeylanica Linn.

Asclepiadiaceae:

Ceropegia lawii Hook, f.

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Gentianaceae:

Exacum lawii Clarke. Canscora diffusa R. Br.

Boraginaceae:

Paracaryum caelestinum Benth.

Convolvulaceae:

Porana malabarica Clarke.

Scrophulariaceae:

Ilysanthes hyssopioides Benth.

Verbenaceae:

Clerodendron serrutum Spreng.

Labiatae:

Coleus parviflorus Benth. Leucas stelligera Wall.

Polygonaceae:

Polygonum pedunculare Wall.

Lauraceae:

Litsaea polyantha Juss. L. wightiana Wall.

Loranthaceae:

Viscum ramosissimum Wall.

Balanophovaceae:

Balanophora indica Wall.

Euphorbiaceae:

Euphorbia fusiformis Ham.

Urticaceae:

Ficus palmata Fors.

Cupuliferaceae:

Quercus robur Linn.

Hydrocharitaceae:

Blyxa echinosperma Hook, f.

Orchidaceae:

Dendrobium pierardi Roxb.

Phaius albus Lindl.

Habenaria grandiflora Lindl..

H. crassifolia A. rich.

Scitamineae:

Hedychium coronarium var. flavum Roxb.

Haemodoraceae:

Ophiopogon intermedius Don.

Amaryllidaceae:

Crinum brachynema.

Agave vivipara Linn.

Commelinaceae:

Aneilema spiratum R. Br.

A. sinicum Lindl.

Aroidae:

Arisaema murrayi Hook.

Cyperaceae:

Pysreus capillaris Nees.

Filiceneae:

Polypodiaceae:

Asplenium lunulatum var, trapeziforme Roxb.

Anisogonium esculentum.

Aspidium polymorphum Wall.

Forest Constituents

Recently Santapau (1960) has given in Proc. Sum. Sch. Bot. Darjeeling, 1960: (30-60) the following plants which occur mostly in deforested areas at Mahabaleshwar:—

Pteridium aquilinum Kuhn

Crotolaria retusa Linn.

Lasiosiphon eriocephalus Decne.

Randia brandisii Gamble.

Memecylon umbellatum Burm.

Syzygium cumini (L.) Skeels.

Olea dioica Roxb.

Actinodaphne angustifolia Nees.

Hitchenia caulina Bak.

Cryptocoryne tortuosa Blatt. McC.

Paracaryum malabaricum Clarke

P. lambertianum Clke.

Ligustrum neilgherrense var. obovat. Clke.

Strobilanthes spp.

Solanum giganteum Jacq.

Glochidion hohenackeri Bedd.

Ficus glomerata Roxb.

Pygeum gardneri Hook. f.

Nothapodytes foetida Sleum.

Canthium dicoccum Merr.

Terminalia chebula Retz. Osyris wightiana Wall.

Callicarpa tomentosa Mutt.

Callicarpa tomentosa Murr

Pavetta indica Linn.

Colebrookea oppositifolia Smith.

Pogostemon plectranthoides Desf.

Carvia callosa Bremek.

Psychotria truncata Wall. Embelia tsiariam cottam DC.

Thejepaepale ixiocephala Bremek.

Elaeagnus conferta Roxb.

Scutia circumcissa Radlk.

Jasminum malbaricum Wt.

Embelia viridifloria Comm.

Piper hookeri Miq.

Smilax zeylanica Linn.

Capparis longispina Hook. f. and Th.

Oplismenus sp.

Lepidagathis cuspidata Nees.

Monsoon Flora:

. Lecanthus pediuncularis Dichrocephala sp. I. pulcherrima I. acaulis Begonia crenata Asystasia dalzelliana Hitchenia caulina Bak. Zingiber macrostachyum Eriocaulon spp. Utricularia spp. Anotis lancifolia Wall. A. foetida Benth and Hook f. Ammannia sp. Heracleum concanense Paracaryum malabaricum Rotala floribunda Sonerila scapigera Exacum pumilum Griseb. E. bicolor Roxb. Uticularia striatula Senecio grahamii Canscora diffusa Smithia setulosa Dicoelospermum ritchiei Mucuna monosperma Habenaria heyneana Lindl. H. grandiflora Lindl. H. panchganiensis Sant and Kapad. Remusatia vivipara Schott. Plectranthus stocksii Hook. f. Begonia crenata Dryand Impatiens dalzellii Hook. f. and Th. I. balsamina Linn. सत्यमव जयत Utricularia caerulea Linn. U. affinis Wt. Hypoxis aurea Linn. Scilla hyacinthina Macbr. Anagallis pumila Swartz Lindernia sessiliflora Wettst. Linum mysorense Heyne Polygonum nepalense Meisn. P. chinense Linu. Pimpinella monoica Dalz. Heracleum concanense Dalz. Lecanthus peduncularis Wedd. Cyanotis cristata Shult. Asvstasia dalzelliana Sant. Curculigo orchioides Gaertn. Zingiber macrostachyum Dalz. Commelina hirsuta Ham. Arisaema longecaddatum Blatt,

Dry Season Herbs:

Conyza stricta Wall. Rungia pectinata Nees Leucas stelligera Wall,

A-127-39-A.

Biological Spectra of Matheran and Mahabaleshwar Flora

A different approach to the study of the Flora of Mahabaleshwar has been made by Dr. F. R. Bharucha and Miss D. B. Pareira (1941) J. I. B. S. 20 (4): 195-211. They studied the flora of these two hill stations on the basis of Raunkier's Life Forms. It is a statistical study of the flora and factors operating. This was possible only because both these places have limited boundaries and because the climatic data is fully known and complete. After analysing the data for both these places, climatic and topographic co-relation was sought with the Biological spectra of other tropical lands. They have concluded that both these places show decidedly phanerophytic plant climate with 52 % and 48 % phanerophytes, respectively. A list of references to their flora is given below in the hope that it will help preparing a complete flora of Mahabaleshwar.

Recently Prof. P. V. Bole started publishing papers in J. B. N. H. S. on the flora of Mahabaleshwar with many additions. They may be consulted.

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3.4. Plants of Koynanagar:

Like Mahabaleshwar there is rich flora at Koynanagar.

Koynanagar is a new township in the hilly region of Satara district, 20.8 km, from Patan. It is approached by a road from Patan going to Chiplun through a short steep ghat of Kumbharli.

Koyna is a tributary of Krishna. It rises with four other rivers (three of which are tributaries of river Krishna) from Kshetra Mahabaleshwar and flows southwards in the valley below Pratapgad till it reaches Helvak. Here it turns eastwards and proceeds towards Karad where it meets Krishna.

Koynanagar has become very famous of late on account of two things. (1) The High Level Hydro-electric Project generating electricity and supplying it to Bombay and several places in Maharashtra; (2) Recent severe earthquake in the area which affected nearly 100 villages and some towns in the neighbourhood. The carthquake came as a rude shock to scientists, especially to geologists who used to believe that Deccan plateau is the most stable part of Peninsular India. Some experts held that impounding of such vast mass of water at such a high level has caused earthquake, while others said that it is due to tectonics, the deep rock strata being unstabled. Still others held that impounding of vast mass of water has not caused the earthquake but it only triggered off the earth tremors as the substrata here have not been stabilised.

Due to creation of the vast lake, several areas have been submerged. There is perpetual humidity here. Many plants must have disappeared and new ones have come. In course of time the flora here is bound to change. Opposite Helvak on the west bank of the river Koyna, there is a virgin forest in the vicinity. This and several other areas have not yet been explored.

The tail water of Koyna dam at Pophli goes through a tunnel (a drop of 1600-2000) straight to turbines in the underground power house. Afterwards the water goes in Vasishthi river going to Chiplun. Dr. G. V. Joshi found that this has changed the composition of trees on this river banks and has altered the factors affecting the mangrove plant community on the Vasishthi river. There is no information whatsoever of the plants and forest communities here, and therefore, the following checklist of plants in the vicinity of Koynanagar as prepared by Dr. S. D. Patil of Poona University is given in the hope that it will encourage further exploration of this place. Besides, these plants, some plants from North Kanara and Goa flora are also found here. This is not to be wondered as the rainfall here is 5000 mm or more, and the place is isolated. It is adjacent to them and is a part of the same botanical province as Malabar. The following lists give important plants at Koynanagar and surroundings.

It will be seen that they are a strange mixture of dry parts of Sahyadri both in Konkan and Desh. The most remarkable elements are those that are common to Koynanagar, North Kanara and Goa.

Plants of Koynanagar area

Ranunculaceae:

Clematis gouriana Roxb.

C. triloba Heyne

C. hedysarifolia DC

C. wightiana Wall,

Menispermaceae:

Cyclea burmanni Miers

Papaveraceae:

Argemone mexicana L.

Polygalaceae:

Polygala erioptera DC. P. persicariaefolia DC.

Elatinaceae:

Bergia capensis Linn.

Guttiferae:

Ochrocapos longifolius Benth.

Mesua ferbea Linn.

Thymelaceae Lasiosiphon eriosophalus

Portulacaeae:

Portulaca oleracea L.

Malaceae:

Urena lobata Linn.

U. sinuata L.

Kydia calycina Roxb.

Thespesia papulnea L.

Elaeocarpaceae:

Elaecocarpus oblongus Gqaertn

Linaceae:

Linum mysorense Heyne

Rutaceae:

Murraya koenigii

Balsaminaceae:

Impatiens acaulis Hook.

Icacinaceae:

Mappia foetida Miers

Rhamnaceae:

Columbrina rathina Laws.

Scutia indica Brongn.

Zizvphus jujuba Lamk.

Z. oenoplea Mill

Z. rugosa Willd.

Z. xylocarpa willd.

Vitaceae:

Vitis elongata Wall.

V. lanceolata L.

V. woodrowii (Stapf) Santapau

Leea sambucina Willd.

L. macrophylla Roxb.

Anacardiaceae:

Mangifera indica L.

eguminosae: sub fam. Mimosae:

Acacia concinna DC. A. intsia Willd. add.

Sapindaceae:

Allophylus cabbe Bl.

Combretaceae:

Calycopteris floribunda Lamk. Terminalia chebula Retz T. paniculata Roth T. tomentosa W, and A.

Myrtaceae:

Syzygium cumini (Linn) Skeele Eugenia heyneana Duthie

Lythraceae:

Ammania beccifera Linn
A. floribunda Clarke
Woodfordia fruticosa Salisl
Lagestroemia lanceolata Wall
Lawsonia inermis L.

Aizoaceae:

Mallugo hirta Thumb. M. pentaphyllya L.

Umbelliferae:

Carum stictocarpum Clarke Pimpinella adscendens Dalz. Heracleum concanicum Dalz.

Rubiaceae:

Wendlandia notoniana Wall. Pavetta indica L. Rubia cordifolia L.

Compositae:

Vernonia cinerea (Linn.) Lesg.
Adenostemma viscosum Forest
Ageratum conyziodes L.
Gnaphalium indicum Linn.
Vicoa indica (Willd.) DC.

Myrsinaceae:

Maesa indica Wall.

Styraceae:

Symplocos beddomei Clarke

Oleaceae:

Jasminum malabaricum Wt. Ligustrum neilgherrense St. var. obovatum Clarko

Apocynaceae:

Carissa congesta Wt. Halarrhena antidysenterica Wall. Wrightia tomentosa R. and S.

Asclepiadaceae:

Calotropis gigantea R. Br. Asclepias curasavica Linn.

Gentianaceae:

Exacum lawii Clarke E. pumilum Gris.

Boraginaceae:

Cynogolossum denticulatum C C. malabaricum Clarke

Convolvulaceae:

Lettsomia elliptica Wt. Merremia emarginata Hall. f.

Solanaceae:

Solanum giganteum Jacq.

Scrophulariaceae:

Verbascum coromandelianum (Vahl) Kuntze Bonnaya veronicaefolia Spreng. Veronica anagallis Linn. Striga euphratisoides Benth. S. gesneroides (Willd) Vatke Sopubia delphinifolia G. Don.

Acanthaceae:

Asteracantha longifolia (Linn.) Ness
Hygrophila serphyllum T. Anders
Hemigraphis latebrosa Nees var heyneana
Eranthemum roseum (Vahl) R. Br.
Strobilanthes collosus Nees
S. heyneanus Nees
S. ixiocephalus Benth.
S. scrobiculatus Dalz,
Lepidagathis cuspidata (Wall.) Nees
Rungta parviflora Nees

Verbenaceae:

Lantana camera Linn, var, aculeata Moldenke Callicarpa lanata L. Tectona grandis Linn, f. Clerodendrum serratum (Linn) Murr, Vitex negundo L.

Labiatae:

Plectranthus costata Buch Ham.
P. mollis (Ait.) Spr.
Pogostemon parviflorus Benth.
Dysophylla stellata Benth.
Colebrookia oppositifolia Sm.
Anisomeles heywana Benth.
Nepeta hindustana (Roth) var woodrowii
Salvia plebeja R. Br.

Amaranthaceae:

Amaranthus spinosus L. Achyranthes aspera L.

Chenopodiaceae:

Chenopodium ambrosioides Linn.

Polygonaceae:

Polygonum chinense L. var ovalifolium Meissn. P. glabrum Willd.

P. plebejum R. Br. Var. indica Hook f.

P. serrulatum Cooke

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Lauraceae:

Litsea stocksii Hook. f. Actinodaphne hookeri Meissn.

Proteaceae:

Grevillea robusta Cunn

Santalaceae:

Osyris arborea Wall.

Loranathaceae:

Loranthus longiflorus Desf. Viscum angulatum Heyne ex DC. V. articulatum Burm.

Euphorbiaceae:

Euphorbia acaulis Roxb.

E. elegans Spreng.

E. hypericifolia L.

E. rothiana Spr.

Bridelia retusa Spr.

B. squamosa Gehrm.
Acalypha brachystachya Hornem

Homonoia riparia Lour Tragia involucrata Linn.

Urticaceae:

Gerardinia zeylanica Decne. Lecanthus peduncularis (Wall). Pouzolzia bennetteana Wt. Debregaesia velutina Gaud. Boehmeria scabrella Gaud.

Moraceae:

Trema orientalis Bl Ficus arnottiana Mig. F. bengalensis L. F. infectoria Roxb. F. glomerata Roxb. F. retusa L.

Salicaceae:

Salix tetrasperma Roxb.

Orchidaceae:

Oberonia rupestris Blatter and McCann Aeridas erispum Lindl. Habenaria commelinifolia Wall. H. digitata Lindl.

Zingiberaceae:

Hedychium coronarium Koning Zingiber macrostachyum Dalz, Costus speciosus Sm.

Amaryllidaceae:

Curculigo orchioides Gaertn.

Liliaceae:

Smilax macrophylla Roxb. S. zeylanica L. Gloriosa superba Linn.

Commelinaceae:

Commelina forskalei Vahl. Cyanotis axillaris Schult. f. C. cristata Schult. f. C. tuberosa Schult.

Palmae:

Caryota urens L.

Araceae:

Cryptocoryne retrospiralis Kunth Remusatia vivipara Schott. Arisaema murrayai (Grah.) Hook,

Cyperaceae:

Kyllinga brevifolia Rottb, K. triceps Rottb, Carex filicina Nees

Gramineae:

Coix lacryma-jobi L. Thelepogon elegans Roth Apluda aristata Linn. Arthraxon echinatus Hochst. A. meeboedii Stapf A. hugelii (Hock.) Camus Themeda cymbaria Hack. Iseilema laxum Hack, Eragrostis stagnina Beauv. E. nutans (Retz) Nees Oplismenus burmanni P. Beauv. O, compositus Beauv. Isachne lisboae Hook. F. Sporobolus dianaer Beauv, Cynodon dactylon Pres. Eleusine coracana Gaertn. Dactyloctenium aegyptium Beauv. Themeda jacquemontit Stapf, T. lisbboae Stapf. Bambusa arundinacea Retz, B. vulgaris Schrad. Oxytenanthera ritchei Dendrocalamus strictus Nees

3.5: Plants of North Kanara found at Koynanagar:

Dilleniaceae:

Dillenia indica L.

Menispermaceae:

Cissampelos pareira L.

Cruciferae:

Nasturtium officinale R. Br.

Flacourtiaceae:

Flacourtia latifolia Cooke

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Dipterocarpaceae:

Hopea wightiana Wall

Malvaceae:

Hibiscus furcatus Roxb.

Bombacaceae:

Bombax ceiba L.

Sterculiaceae:

Helicteres isora L.

Tiliaceae:

Triumfetta rhombifolia Jacq.

Rutaceae:

Toddalia asiatica Lamk Atlantia monophylla DC

Olecaceae:

Canscora rheedii

Celastraceae:

Salacia prinoides DC Gymnosporia rothiana Laws

Hippocrateaceae:

Hippocratea obtusifolia Roxb.

Sapindaceae:

Hemigyrosa canescens Thw. Sapindus emarginatus Vahl. Allophylus cobbe Bl.

Anacardiaceae:

Anacardium occidentale L. Holigarna grahamii Hook H. arnottiana Hook

Leguminosae (Papilionaceae): Crotolaria retusa L.

Capparidaceae:

Nasturtium officinale R. Br. Cardamine trichocarpus

Fabaceae (Leguminosal):

Sub-fam-Caesailpinioideae:

Wagatea spicata Dalz.

Bauhinia vahlii W. and A.

Sub-fam-Papilionaceae:

Heylandia latebrosa DC Crotalaria filipes Benth.

C. mysorensis Roth.

C. retusa L.

Indigofera pulchella Roxb. Smithia hirsuta Dalz.

S. purpurea Hook.

Aeschynomene indica L. Alysicarpus rugosus DC.

A. tetragonolobus Fdgew.

A. vaginalis DC
Desmodium rotundifolium Baker
D. triflorum (L.) DC
Alylosia lineata W. & A.
Cylista scariosa Roxb.
Pongamia glabra Benth.

Sub-fam-Mimosae: Entada pursaetha DC

Crassulaceae:

Kalanchoe pinnata Pers.

Combretaceae: Combretum ovalifolium Roxb.

Myrtaceae:
Syzygium toddelioides Wight

Lacythidaceae: Caryea arborea Roxb.

Lythraceae:
Rotala indica Koehne
Lagerstroemia speciosa Pers.

Begoniaceae:
Begonia crenata Dryand

Rubiaceae:
Wendlandia thyrsoidea Steud.
Canthium dicoccum Merrill
Ixora nigricans Br.

Compositae: Gnaphalium leuteo-album L.

Sapotaceae:

Xantolis tomentosa Raf.

Oleaceae:
Olea dioica Roxb.

Apocynaceae:
Alstonia scholaris R. Br.
Tabernaemontana divaricata R. Br.
T. heyneana Wall.

Boraginaceae:
Trichodesma zeylanicum R. Br.
Adelocaryum coelestinum Brand

Solanaceae: Solanum nigrum L.

Bignoniaceae:
Heterophragma quadriloculare K. Sch.

Acanthaceae:
Dipteracanthus prostratus Nees
Eranthemum purpurascens Nees
Lepidagathis fasciculata Nees
Barleria prionitis L.

Haplanthus verticillatus Nees Hemigraphis latebrosa Nees var heyneana Justicia trinervia Vahl J. procumbens L. Adhatoda vasica Nees

Verbenaceae:

Phyla nodiflora Green Premna coriacea Clarke

Labiatae:

Dysophylla quadrifolia Benth.
Pogostemon heyneanus Benth.
Anisomeles malabarica R. Br.

Nyctaginaceae:

Boerhaavia diffusa L.

Amaranthaceae:

Aerva lanata L.

Polygonaceae:

Polygonum chinense L. var ovalifolium

Piperaceae:

Piper longum L.

Loranthaceae:

Dentropthoe falcata Etting.

4. FLORA OF PUNE DISTRICT

The district of Pune stands on a lofty height 1800' or more. Climate is breezy; rainfall and temperature are moderate, determined by the height of the places, but never extreme. Soil is gravelly or mixture of gravel and sand, but nowhere alluvial.

The flora and vegetation of Pune district have been worked out by a number of workers. Several early botanists such as Jacquemont, Gibson, Dalzell, Kirtikar and Cooke (1903—1908) have worked on Pune. Later Blatter and McCann, Santapau, Vartak, Razi and others have described plants of a number of places in Pune district in their writings. This is because Pune had been the headquarters of the Bombay Government during monsoons in the past, and because several Government departments like Forest. Agriculture, Education, Irrigation etc. are located here. The tradition of formal botanical studies at Pune was established by early botanists, Dr. Theodore Cooke, Woodrow, Bhide who had been working here for a long time.

The wall of the Deccan trap hills lies to its north-west and west. When they disintegrate they form murum and produce soils partly sandy and partly sticky having various shades of red or red and black colour. They are generally poor and shallow. In the eastern part of Pune they are dry and poor. As is known the Deccan trap consists of layers after layers of trap and when they disintegrate produce steps-like appearance. This is seen in many places around Pune, but it is highly conspicuous in Sinhagad range of Sahyadris. Pune City stands at the confluence of Mula and Mutha rivers.

The town of Pune also lies at the apex of Mutha river basin or Maval, and it has like other Mavals peculiar climate. The vegetation in the dry

hills is composed of a few trees and shrubs which become conspicuous against the background of dark rocks. Invariably one finds here Anogeissus latifolia, Ficus glomerata, Hamiltonia suaveolens, Boswellia serrata Zizyphus rugosa, Dolichondrone falcata, Crissa congesta, Lavendula vera, Carvia callosa, Ficus arnottiana, Woodfordia fruticosa. At higher altitude above 3000' the flora changes to semi-evergreen and sometimes forms evergreen pockets in ravines.

The terrain throughout this district is undulating. The northern and western parts are beset with hills from the spurs of Sahyadris; their high peaks are all isolated e.g. Rohideshwar, Purandar, Sinhagad, Bhimashankar, Shivaneri etc. On many of these peaks there are hill forts separated from each other. They have preserved some rare species in their enclosures. The peaks though isolated from each other have similar vegetation due to similar rainfall, temperature range and soil. They are possibly the fragments of old continuous vegetation in distant past, but now discontinuous, because the trap rocks between them are disintegrated and washed away. They do not have uniformly hard or soft basalt. Therefore, they form gullies and valleys which later get filled with earth and vegetal matter from the upper flats.

4:1: Previous work on the Flora of Pune:

Pune district has varied terrain from the edge of Sahyadris at the north and north-west. It is nearly flat and arid in the low rainfall area. Acacia tract lies to the south and south-east near Daund, Indapur, Yavat and Shirur. The flora naturally is varied. Flora of the remaining region between the two regions, east and west, lies in the medium rainfall Zone The flora of Khandala, Ambavane and Sakharpathar, Mulshi. Bhimashankar has been developed in the high rainfall region, whereas, that of Daund, Shirur and Pune has developed in the arid low rainfall region. Flora of Pune, Talegaon, Purandar, Junnar is in the medium rainfall region.

Pune has been the headquarters of the Botanical Survey of Western India ever since it was started in 1890—1893, and was restarted in Pune in 1956. The Western Circle of it is in Pune. Dr. Gibson, Dr. Cooke, Prof. Woodrow, Dalzell and a number of other botanists such as Gammie, Stocks, Bhide, Kanitkar, H. P. Paranjape, Santapau and Vartak worked on Pune plants and also the members of the Agriculture and Forest Departments, and those in the Botanical Survey of India. The Flora of Pune district on account of their efforts, is better known than that of many other districts. But there is no comprehensive account of the Flora of the Pune district as a whole. Therefore, flora of the representative areas in the three rainfall regions only would be described here. Plants of Pune and surroundings are frequently mentioned by Cooke (1901—1908) in his Flora of the Bombay Presidency, but a more comprehensive account of the plants of Pune district and surrounding hilly regions is given by Razi (1952). Since this is a fairly detailed and recent list of plants of Pune, it is given briefly below.

Razi (1952) has also made some general observations on the forests of Pune which, according to him, belong to three classes: (1) forests in the hilly region, (2) forests on the river banks, and (3) upland reserved forests, Government as well as private. The private reserved forests are mostly in the hilly tract of Maval and Mulshi to the west of Pune. The valleys of Maval and higher slopes of Sahyadri ranges in the district have small evergreen or semi-evergreen forests, but due to several hill forts having been constructed on the crests of Sahyadris, the forests around

them were destroyed to avoid hiding by enemies. The second category of forests are the close strands of Acacia arabica, Syzygium jambolana, Pongamia glabra on the banks of rivers cutting their way through Maval region and flowing to the east in their basins. The third class of these forests are in the highland region of Maval, Mulshi, Ambavane and Khandala. They are both Government and private. In other parts in the plains and on the low hills there are deciduous forests.

The deciduous forests of Pune have also been studied by Garland (1933), by Puri and Vasavda (1957), Qureshi (1962), Mahajan, Jain, Ansari and others. Jain and Hemadri have collected several grasses, as there are many pasture lands in the vicinity of Pune, right up to Talegaon on one side and up to Purandar on the other side. Plants of hills around Pune have been studied by Vartak (1957—1959). He has also drawn attention to many interesting plants of Pune and Satara districts and has described the flora of Katraj. The trees within the Pune Municipal Corporation area and plants of Mutha river bed have also been described by him (1957—1964) besides some grasses (1973). Earlier Ezakiel (1916) had described the plants and ecology of the Chatushringi hill reserve forest. Several members of Agriculture Department have described the grasses, legumes and some useful plants of this region, especially Dr. Burns, Kulkarni and Godbole (1925—1931). The flora of Ganeshkhind area has been described by Varadpande (1973).

An important feature of the Pune district is the hill forts. The flora of these is better preserved within the fort walls, and Santapau (1957) has described the flora of Purandar, Torna and Sinhagadh. He (Santapau 1966) has given a comprehensive account of the flora of the hill forts in Maharashtra in general. Vartak (1953) has described the flora of hill fort Rajgad. Earlier a more detailed account of the grasses of Pune has been included by Blatter and McCann (1925) based on Bhide's collection. Razi (1952) has enlisted them further.

In the hilly regions of Pune, there is high rainfall generally on the crests, but plains have low or medium rainfall on account of which they have sparse deciduous forests and scrub. The trees common are Mangifera indica, Lagerstroemia parviflora, Adina cordifolia, Salmalia malabarica Tectona grandis. In moist deciduous forests Tectona grandis, Terminalia bellerica, Grewia tiliaefolia, Boswellia serrata, Terminalia tomentosa merge into semi-evergreen forests, and in arid region they get mixed with scrub formed by Gymnosporia marginata, Carissa congesta, etc. The scrub consisting of Acacia leucophloea gets merged with open grasslands found throughout the district in medium and low rainfall regions. However, there is no systematic effort to introduce new grasses or to know of the conditions under which they could be regenerated. Dr. Razi (1952) has drawn attention to these open grasslands as an important feature of the flora of Pune district.

Among the high rainfall region, the flora of Khandala has been thoroughly worked out by Santapau (1957) and the plants of Ambavane-Sakharpathar have been enlisted by Reddi (1970). The account of the medicinal plants of Khed taluka and plants of Bhimashankar has been given by Janardhanan (1963). The plants of Junnar were studied by K. Hemadri but the work is unpublished.

The district contains some rare plants and endemics. The best known of these Frerea indica is found in the ledges of rocks and on fort walls at Junnar. Recently this plant has been rediscovered at Mahabaleshwar

below the Kate's point by McCann and in the crevices of rocks of Vazirgad in Purandar fort by Santapau. This is a member of the Asclepidaceae looking like a cactus and has very showy flowers. It is a world endemic but is fast on way to extinction. There are many species of Ceropegia described as new by Ansari (1968—1972). A new genus of the same family called Seshagiria has been described by Hemadri, Ansari and others. The deciduous forests of Pune district are also described by Puri and Vasavda (1957). There was an exquisite Forest Park, developed on about 40 hectares of land at the base of hilly region in the bend of Kukdi river at Hiwre (Junnar taluka). This was started by Dr. Alexander Gibson in 1840, wherein he developed a method of blending exotic trees and bushes with those naturally occurring here, but to the great dismay of botanists this park is now submerged under the lake formed by the high level dam on the Kukdi river, and thus the work of a pioneering botanist and forester of rare attainments of the stature of Dr. Gibson has come to a sad end!

Important papers dealing with the flora of Pune district are given below after the account of erstwhile Gibson's Park.

4.2: Rainfall regions of Pune and their flora:

The flora of Pune district has been concentrated in three markedly different regions:

- 1. Dry eastern low rainfall region-beyond Yavat upto Daund, Pomalvadi, Shirur, where the rainfall is 33"—35" or less, not more than 34" as a rule. Soils are mostly gravelly. This is a low rainfall area.
- 2. High rainfall area to the west and north-west adjacent to Sahyadris.—Rain in this region at places exceeds 200", but generally at most of the places, it is 50—100". The region faces ghats and overlooks Konkan. It gets more rain because Sahyadri blocks clouds (Bhor, Rohideshwar, Mulshi, Ambavane, Khandala, Bhimashankar, Sakhar-Pathar). Rainfall in this region, mostly Mavals, is high. Like trap layers, vegetation is banded alternating with traps e.g. in Bor Ghat near Khandala.
- 3. Medium rainfall region or the Intermediate region having 48"-50" of rain. Pune, Junnar, Talegaon, Urali-Kanchan lie in it.

The first region above is dominated by Acacia, arabica var Ramkathe, Flacourtia ramontia and low shrubs of Capparis grandis. Next to Andhra Pradesh Acacia tract this is another typical Acacia tract. It lies in the basin of Bhima river and is mostly dry throughout the year. The ratio of dry to humid period is 9:3 and that determines the arid or semi-arid nature of the region.

The first region receives heavy monsoons for about 5 months, July and August being the wettest months. It has moist deciduous or semi-evergreen forests dominated by Anogeissus latifolia, Terminalia tomentosa, T. chebula, Mitragyna parviflora, Mangifera indica. At higher altitude the valleys and ravines contain evergreen species of Actinodaphne hookeri, Garcinia indica, Lagerstroemia parviflora, Grewia undiflora, T. ramontchia, T. arnottiana, and several herbaceous members of the Rubiaceae, Leguminosae, creepers of Combretum, Glochidion hohenakeri, Gmelina arborea, Cetba malabarica, Syzygium cumini etc. Tectona grandis as a rule is not present in evergreen forests, as it needs some dry period for full growth.

Some of these forests merge in semi-arid areas into dry deciduous forests in which Lannea grandis, Tectona grandis occur. In open spaces, wastelands, gravel, poor soil, highly eroded places and slopes, only grass grows. There are extensive open grasslands around Pune at Katraj, Talegaon, Shirur, Pomalvadi, Junnar, but only in rainy season. Grass lasts till about January. They serve as pastures. Their ecology has been studied by Burns et. al (1925, 1931). In medium rainfall region there is scrub jungle in which Acacia leucophloca, Rhus mysorensis, Flacourtia ramontia, F. macrophylla, Woodfordia fruticosa occur here and there. Thus the vegetation of the three regions looks different from each other. Flora of the more important typical places in each, is described here as representative of these regions.

4.3: Flora of Chatushringi and Vetal Hills:

Chatushringi and Vetal hills are close to Pune University Campus separated by a road going to Government House, and thence to Aundh village. They are typical trap hills, dry, and with little or on soil on top flats. They lie in medium rainfall region, and as such, are semi-arid. A number of xerophytes, shrubs, herbs and a few trees of Acacia leuoephloea, Rhus mysorensis, Dolichondrone falcata grow on them, with grasses. Some leguminous herbs grow on them during rainy season. Drought period extends for about eight months. During summer they all dry up and only trees remain here and there. Tuberous plants, creepers, some calcicoles persist with a few petrophytes but all the rest of ground flora dies.

Ezakiel (1947) has worked on the ecology and flora of Chatushringi forest reserve. The common surface herbaceous flora towards the end of rainy season consists of Tridax procumbams, Boerhavia diffusa, Echinops echinatus, Indigofera linifolia, Polygala erioptera, Linaria ramosissima, Evolvulus alsinotides, Striga luteota and other species like Justicia diffusa, Sopubia delphinifolia, Phyllanthus niruri, Mimosa hamata etc. Mixed with these there are succulent plants like Sarcostemma brevistigma, Cynotis tuberosa, Cynotis axillaris, Caraluma fimbriata, Asparagus recemosus. Lians like Vitis repanda, Vitis woodrowii, Vitis setosa, Hemidesmus indicus grow mixed with them. Straggling on Acacia leucophloea and other trees are Ceropegia tuberosa, Dragea volubilis, Leptadenia reticulata, Rivea hypercrateri formis. Scilla indica, Chlorophytum tubererum, Ophioglossum aitchisoni. The trees of Bauhinia racemosa, Dolichondrone falcata are few and fewer still are the trees of Tectona grandis, but the bushes of Rhus mysorensis are many.

These hills form typical dry thorny scrub. Similar vegetation is seen in semi-arid region in many places in Maharashtra, and particularly in low rainfall zone around Pune.

4.4: Flora of Ganeshkhind Area:

Opposite the Chatushringi hill lies the Range hill in Ganeshkhind (18°34'N Lat. 73°53' E Long.) in the Poona University Campus. It is separated by a road leading to Government House and Pashan. The area of the University campus is 412 acres. It is a plateau, a kind of pediment surface in which the Tertiary basalt of amygdaliodal type is seen and also some compact hard basalt in a few places. The soil is poor, alkaline, and it is mostly derived from sand and gravel. June to October is rainy season, there being about 50 rainy days, and total rainfall is about 40". December-January are the coldest months when the temperature

rarely reaches to 4° C. April-May are the hottest when it reaches 39°-41° C. There is great variation in day and night temperatures upto 20°C. Thunder showers are occasional in April and May. Relative humidity varies from 20% in the morning to 71-78% in the afternoon. The direction of the wind is generally south-west to north-east.

Vegetation.—According to Varadpande (1973) there are 780 species spread over 540 genera and 118 families. Dicots constitute 415 genera and monocots 96. Families Leguminosae, Compositae, Euphorbiaceae, Graminae are the large families here.

The vegetation except on the Range hill and in the small valley at the north is xerophytic and is a kind of scrub made up of Acacia chundra, A. nilotica, A. leucophloea, Dalbergia melanozylon, Dolichandon falcata, Dichrostachys cineroa, Capparis grandis, Zizyphus mauritiana and such other deciduous trees. There are a large number of ephemerals and thorny bushes of Securinega leucophyrus, Meytenius senegalensis, Mimosa hamata, Ehretia aspera. In the central area there are hard rocks fully exposed. But in the low lying areas there are many Acacia sp., Albizzia lebbek and thickets of Dalbergia melanoxylon, which are self born.

In the monsoons many ephemerals such as Heliotropium ovalifolium Cyanotis fasciculata, Oldenlandia corymbosa, Glassocardia Boswellea. appear. On the hill there are a few lingering trees of Tectona grandis and Boswellea serrata alongwith newly planted Gliricidia maculata. But they are only few. The hill was probably previously covered by trees but became quite barren later. The eastward side of it is now covered by newly planted Gliricidia maculata and other trees replanted as a part of afforestation scheme of the University, under, the the Botany Department. In the ledges of rocks Chlorophytum nimmonii, C. tuberosum, Urginea indica spring up during rains. On the plain ground Iphigenea indica, Cyanotis tuberosa, Cyperus triceps, Maelanocenchis jacquemontii, Ophioglossum mudicaule, O. gramincum, Chlorophytum laxum come in succession. Of these Ophioglossum gramineum and Chlorophytum tuberosum come at the same time, but are rare. Many trees of Capparis grandis and Dalbergia latifolia and Serotina siliqua (Carob) and other introduced trees form a thick belt of vegetation.

A very remarkable feature of the area is the mixture of exotic trees such as Adansonia digitata, Brownea sp. Erythrina indica, Collvillea racemosa, Gmelina arborea, Brassiea umbellata. They form a formal garden and merge with the natural vegetation. The whole area makes a landscape garden. The place, though typically xerophytic, merges with the exotic plants, so planted as to have some trees with flowers every month, This was probably done at the suggestion of Dr. Gibson, Superintendent of Botanical Garden then at Dapodi.

The whole area was designed by Sir Humphrey Repton as a 19th century English landscape garden with undulating grassy plains, shrubby paths lined by African bush, Dalbergia melanoxylon, a thick woodland towards the low lying valley in the middle. This leguminous bush gets completely defoliated in winter, looks dry and denuded in summer, but with the advent of first rains, it produces millions of small white fragrant flowers in great profussion on otherwise leafless bushes. In other months it is all green and presents pleasant green appearance. They change to yellow before leaf-fall in winter. The whole thing gives an appearance of English landscape. The paths resemble with the backs of the colleges in Cambridge and Oxford.

The old Government House is now Poona University Building and Senate Hall. It contains many frescoes of English plants, coat of Arms and emblems of early British Governors in the last century. This is perhaps the only place where 19th century English landscape garden wherein formal garden and natural vegetation are blended together into landscape simulating the Blenheim Palace near Oxford with all its English effects. The list of important exotic plants mixed with natural vegetation is marked with asterisk in the list below.

A significant feature of the Ganeshkhind Botanical Garden is a huge tree of banyan, Ficus bengalensis. It has 25-30 stumps of stilt roots, and is spread over about half a furlong in expanse reminding one of the famous banyan grove spread over an acre in Indian Botanical Gardens at Shibpur, Calcutta, or the banyan near Pachvad on way to Wai from Satara, or the famous Kabir Vad near Bharuch.

A list of selected plants is given after Varadpande (1973).

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Ranunculaceae:

Clematis trilaba Heyne

Berberidaceae:

*Nandina domestica Thunb.

Capparidaceae:

Cadaba fruticosa Druce Maerua arenaria Hook.

Bixaceae:

Cochlospermum gossypium DC. Flacourtia indica Merr.

Malvaceae:

Sida verenicifolia Lamk.

Bombacaceae:

Bombax ceiba Linn.

*Adansonia digitata Linn. Ceiba pentandra Gaertn.

Zygophyllaceae:

*Guaiacum officinale Linn.

Oxalidaceae:

*Averrhoa carambola Linn.

Geraniaceae:

Monsonia senegalensis Guill and Perr.

Rutaceae:

*Rivinia spectabilis Griseb.

Ochnaceae:

*Ochna squarrosa Linn.

Burseraceae:

Boswellia serrata Roxb. Garuga pinnata Roxb.

*Bursera delpechiana Peiss.

Celastraceae:

Gymnosporia montona Benth. Elaeodondron roxburghii Wt. and Arm.

A-127-40-A.

Rhamnaceae:

Zigyphus mauritiana Lamk. Z. xylopyra Willd.

Sapindaceae:

*Filicium decipens Thw.

Anacardiaceae:

Rhus mysurensis Heyne
Lannea coromandelica Merr.

Papilionaceae:

*Crotolaria juncea Linn. Crotolaria mysorensis Roth. Melilotus alba Desr.

Psoralea corylifolia Linn.

Tephrosia strigosa Santapau and Mahesh.

*Milletia ovalifolia Kurz. Butea monosperma Taub.

Dalbergia sissoo Roxb. *D. melanoxylon Guill

D. latifolia Roxb.

D. lanceolaria Linn.
*Gliricidia sepium Steud.

Caesalpiniaceae:

Caesalpinia sepiraia Roxb.

*Delonix elata Gamble

Rhizophoraceae:

*Carallia brachiata Merr.

Combretaceae:

Terminalia tomentosa Wt. and Arn.

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*Anogeissus pendula Eedgew.

Myrtaceae:

Syzygium cumini Skeels

*Callistemon lancealatus DC

*Melaleuca leucadendron Linn.

Lecythidaceae:

Careva arborea Roxb.

Melastomaceae:

Memecylon umbellatum Burm.

Lythraceae:

Woodfordia fruticosa Kurz

Cactaceae:

*Pereskia grandiflora Hort.

Caprifoliaceae:

*Lonicera japonica Thumb.

Rubiaceae:

*Pentas lanceolata K. Schum. Gardenia resinifera Roth.

*Coffea arabica Linn.

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Compositae:

Vernonia cinerosa Less.
Ageratum conyzoides Linn.
Artemisia nilgeirica Pamp.
*Acanthospermum hispidum DC.
*Parthenium hysterophorus Linn.
Senecio grahami Hook.
Solidage canadensis Linn.

Campanulaceae:

Isotoma longifolia Juss.

Plumbaginaceae:

Plumbago zeylanica Linn. P. rosea Linn.

Sapotaceae:

*Chrysephyllum cainite Linn.

Ebenaceae:

Diespyros peregrina Gurke. D. mentana Roxb.

Myrsinaceae:

*Jacquinina ruscifolia Spreng.

Oleacea:

Olea europaea Linn. *O. fragrana Linn.

Apocynaceae:

Rauvolfia canescens Linn.
R. serpentina Benth.
Vallaris solanacea Kuntze
Beaumontia grandiflora Wall.
Alstonia scholaris R. Br.
Holarrhena antidysenterica Wall.
Wrightia tomentosa Roem. and Schutt.
W. tinctoria R. Br.
*Aganosoma carophyllata G. Don.
*Roupellia grata Wall. and Hook.
Trachelospermum fragrans Hook.

Asclepiadaceae:

Hemidesmus indicus Schult.
Cryptolepis buchanani Roem, and Schult.
Pergularia daemia Choiv.
Sarcostemma brevistigma Wight.
Dregea volubilis Benth.
Ceropegia hirusta Wt. and Arn.
C. bulbosa Roxb.
Caralluma fimbriata Wall.
Cryptostegia grandiflora R. Br.
*Stapelia grandiflora Masson

Frerea indica Dalz.

Loganiaceae:

Buddleja asiatica Lour.
B. madagascariensis Lamk.

Gentianaceae:

Exacum pumilum Griesb.

Convolvulaceae:

Porama paniculata Roxb.

P. racemosa Roxb.

Rivea hypocrateriformis Choisy.

Solanaceae:

Withania sonmifera Dunal.

Datura arborea Linn.

*Brunfelsia americana Linn.

Scrophulariaceae:

Veruascum chinense Santapau

Kickxia ramosissima Janchen.

Striga gratica Linn.

S. densiflora Benth.

S. angustifolia Sald.

S. asiatica Kuntze.

Sopubia delphinifolia G. Don.

Bignoniaceae:

Dolichandrane falcata Seem.

Heterophragma quadriloculare K. Schum

*Millingtonia hortensis Linn.

*Spathodea campanulata Beauv.

*Kigelia pinnata DC.

*Jacaranda mimosifolia D. Don.

*Crescentia cujete Linn.

*Tabebuia pentaphylla Hemsl.

T. rosea DC.

Adenocalymma nitidum Maxt.

Acanthaceae:

Andrographis echioides Necs

Securinega leucopyrous Muell-Arg.

Cicca acida Merill.

*Phyllanthus distichus Muell-Arg.

Putranjiva roxburghii Wall.

Codiacum variegatum Blume.

*Manihat esculenta Grantz.

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Excoecaria bussei Pux.

E. bicolor Hassk.

Orchidaceae:

Habenaria marjinata Coleb. Eulophia pratensis Lindl.

Musaceae:

Musa paradisiace Linn.

*Strelitzia reginae Bank.

*Heliconia angustifolia Hook.

Zingiberaceae:

Glabba bulbifera Roxb.

Costus speciosus Smith.

Agavaceae:

* Yucca gloriosa Linn.

Dioscoreaceae:

Dioscorea alata Linn.

Liliaceae:

Asparagus racemosus var. javanica Baker.

A. virgadus Baker.

Gloriosa superba Linn.

Iphigenia indica A. Gray.

I. pallida Baker.

J. diffusa Willd.

Peristrophe bicalyculata Nees.

Verbenaceae:

Citharexylum subserreatum SW.

*Holmskioldia sanguinea Retz.

*Petrea volubilis Linn.

Labiatae:

Lavandula burmanni Benth. Origanum majorana Linn.

Pogostemon heyneanus Benth.

Amaranthaceae:

Aerva lanata Juss.

Gomphrena cebsioides Martr.

Chenopodiaceae:

Spinacia aleracea Linn.

Piperaceae:

Peperomia wightiana Miq.

Lauraceae:

*Persea gratissima Gaertn.

Proteaceae:

*Grevillea robusta A. Cunn.

Loranthaceae:

Dendropthoe falcata Etting. Viscum nepalense Spreng.

Santalaceae:

Santalum album Linn.

Euphorbiaceae:

Bridelia squamosa Gehrm.

Scilla indica Baker.

Urginea indica Kunth.

Asphodelus tenuifolius Cav.

Chlorophytum tuberosum Baker

C. laxum R. Br.

C. orehidasbrum Lindl.

*Dracaena fragrans Ker. Gawl.

Commelinaceae:

Cynotis axillaris Schutt,

Palmae:

- *Arecastrum roman afflanum Bell.
- *Syagrus coronata Bell.
- *Chrysalidocarpus lutescems Wendl.
- *Cocathrinax argentea Schum.
- *Elaeis guineensis Jaig.
- *Licuala grandis Wendl.

- *Sabal palmetta Ladal.
- *S. adansoni Guers.
- *Rhapis doabelliformis L'Her.
- *R. humilis Blume
- *Caryota sabolifera Wall.
- *C. mitis Lour.

Cyclanthaceae:

*Carludovica palmata Ruitz. and Pav.

Araceae:

- *Philodendron giganteum Schott.
- *Monstera deliciosa Liebrn.

4.5: Flora of Katraj Ghat:

About 13 km from Pune to the south is Katraj ghat, on Pune-Bangalore National highway, 1600' above Pune plain. The pass at the tunnel is 3000' high. It lies at 18°27'N Lat. and 73°52' E Long. The Katraj ghat area is 10 sq miles. It lies on a east-west range of Sahyadri. It has two peaks, the north peak being 3779' and south peak 3703' above M.S.L. They block the clouds. North peak naturally gets more rain. Katraj village has an altitude of 2290' above M.S.L. The tunnel is in between the two peaks in the saddle and commands a glorious view of Pune city. There are two small tanks or lakes known as Mastani's Talav, and an aquaduct at Katraj which supplies water to Pune City.

The hill is a trap hill with 4—6 lava flows traversed by sills and dykes. Rainfall is 28"-34", generally 33-34". Much of it falls in July, August and September. Winds are mostly westerly. There are two ravines on northern slopes. Soil is sandy and not deep. The vegetation, here is determined by poor soil altitude, direction of wind and rainfall, but is also limited by biotic factors, being quite near to Pune city.

Mostly the shrubs of Gymnosporia montana, Zizyphus rugosa, Carissa congesta, Argyreia cuneata, Securinega leueopyrus, Osyris wightiana are in evidence. The whole vegetation is of dry deciduous type. Quite a number of grasses grow here which dry up and hills look barren in summer.

Soon after rains many tuberous herbs like Chlorophytum tuberosum, Dipcadi ursulae, Cynotis fasciculatus begin to appear and rich monsoon flora develops on flats on hills. On the hill top flats Hypoxis aurea, Chlorophytym laxum C. tuberosum, Seilla indica, Iphigenia pallida, Costus speciosum, appear. On way to top one notices Woodfordia fruticosa, Clematis triloba, Anisomeles malabarica, Senecio edgeworthii, Pimpinella monoica, whereas on the topmost flats in crevices of rocks one sees Adiantum caudatum, Actinopteris dichotoma, Urginia indica, Linum mysurense, Cassia mimosoides, Habinaria grandiflora, H. crassifolia, several grasses like Apluda aristata, Aristida faciculata, Heteropogon insignis, Thelepogon elegans occur.

In the ghat Capparis grandis, Ceiba malabarica, Schrebera swietenioides, Caesalpinia bondualla, Cryptolepis buchunani are found. Two most remarkable plants in the ghat are Lannea grandis and Coclospermum gossypirum: on higher parts Anogeissus latifolia is seen. Many weeds like Parthenyum histeroforus and Acanthospermum hispidum have invaded ghat area through man.

Dr. Vartak (1960) has collected about 600 species here, the more important of which are enlisted below. Ratio of dicots to monocots is 3.1: 8, the important families and species number-wise are Leguminosae (87), Gramineae (80), Compositae (48), Euphorbiaceae (25), Cyperaceae (22), Scrophulariaceae (17), Asclepiadaceae (16), Acanthaceae (17), Labiatae (16).

Deciduous species, so common all over Deccan like Tectona grandis or Boswellia serrata are present here, but not in dense formation due to aridity. At the same time plants like Coleus barbatus, Vernonia indica, Habernara crassifolia which are very common at cool places like Panchgani or Mahabaleshwar also occur here at the highest plateau on the hill tops. The vegetation in ravines and valleys is dominated by Boswellia serrata, second story dominants are Anogeissus latifolia, Lannaea grandis, Ougenia dalbergioides, Diospyros melanoxylon, Buchanamia lanzan, Sterculia urens. They are indicative of dry conditions. On the other hand Semicarpus anacardium, Schleichera oleosa are humid species. Obviously the flora is not purely of dry deciduous type. The flora of Katraj, though lies in medium rainfall zone, is remarkable. Grasses here provide ample feed for cattle and contain moist soft as well as woody species.

Table showing relative position of families and species at Katraj as compared with those in India.

Seria No.	Katraj Hills			Species	Position in India	Western peninsula
(1)	(2)	10		(3)	(4)	(5)
1	Leguminosae	6		86	2	2
2	Gramineae	105	11000	80	3	1
3	Compsitae	:	पन्यमेव	48	7	8
4	Euphorbiaceae			25	5	6
5	Cyperaceae			22	8	5
6	Scrophulariaceae			17	• •	• •
7	Acanthaceae			16	••	10
8	Asclepiadaceae			16	6	3

List of Plants in Katraj Ghat Area (after Vartak 1960)

Menispermaceae:

Cissampelos pareira Linn. Stephania hernandifolia Walp.

Cruciferae:

Cardamine trichocarpa Hochst.

Capparidaceae:

Maerua ovalifolia Cambess.

Capparis zeylanica Linn. (=C. horrida Linn.)

Capparis grandis Linn.

Caryophyllaceae:

Polycarpaea corymbosa Lam.

Elatinaceae:

Bergia ammannioidas Roxb.

Malvaceae:

Kydia calycina Roxb.

Urena lobata Linn. (=U. sinuata Linn.)

Abelmoschus esculentus Moemseh.

=Hibiscus esculentus Linn.

Bombacaceae:

Salmalia malabarica Schott.

=Bombax malabaricum DC.

Tiliaceae:

Grewia tiliaefolia Vahl.

G. pilosa Lam.

G. hirsuta Vahl.

Linaceae:

Linum mysorense Heyne.

Malpighiaceae:

Aspidopterys cordata A. Juss. Monsonia senegalensis Guill.

Balsaminaceae:

Impatiens balsamina Linn. Var. rosea Lindl.

Rutaceae:

Murraya koenigii Spreng.

Simarubaceae:

Alianthus excelsa Roxb.

Burseraceae:

Boswellia serrata Roxb.

Meliaceae:

Cipadessa fruiticosa.

Heynea trijuga Roxb.

Celastraceae:

Celastrus paniculata Willd. Gymnosporia montana Benth. Elaeodendron glaucum Pers.

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Rhamnaceae:

Zizyphus oenoplia Mill.

Z. rugosa Lamk.

Ampelidaceae:

Cissus woodrowii Santapau. (=Vitis woodrowii Stapf.)

C. setosa Roxb.

Leea robusta Roxb.

(=L. aspera Edgew.)

L. sambucina Willd.

Sapindaceae:

Schleichera trijuga Willd.

Anacardiaceae:

Rhus mysurensis Heyne.

Papilionaceae:

Crotolaria filipes Benth.

C. mysorensis Both.

C. triquetra Dalz.

C. calycina Serank. C. juncea Linn.

Crotolaria medicaginea Lamk.

Indigofera linifolia Retz.

I. cordifolia Heyne.

I. glandulosa Willd.

I. enneaphylla Linn.

I. hendecaphylla Jacq.

I tinctoria Linn.

I. pulchella Roxb.

Tephrosia senticosa Pers.

T. purpurea Pers.

Sesbania bispinosa Fawcett.

(=S. eculeata Pers.)

Smithia conferta Sn.

S. purpurea Hook.

Alysicarpus monilifera Edgew.

A. vaginalis DC. Var. etyracifolius Baker.

A. tetragonolobus Edgew.

A. bupleurefolius DC.

Ougeinia dalbergioides Benth.

Teramnus labialis Spreng.

Mucuna prurita Hook.

(=M. pruriens DC.)

Erythrina stricta Roxb.

Butea monosperma O. Kuntze.

(=B. frondosa Konig.) Canavalia gladiata DC.

Phaseolus khandalensis Santapau.

(=P. grandis Dalzell).

Atylosia searabaeoides Benth.

=Cylista scariosa Roxb.

Rhynchosia minima DC. Dalbergia sissoo Roxb.

D. latifolia Roxb.

D. lanceolarea Linn.

Pterocarpus marsupium Roxb.

Caesalpinaceae:

Cassia fistula Linn.

Hardwickia binata Roxb.

Bauhinia racemosa Lamk.

Mimosaceae:

Acacia leucophloea Willd.

A. catechu Willd. Var. sundra Prain.

Albizzia lebbeck Beath.

A. odoratissima Benth.

A. amara Boiv.

Combretaceae:

Terminalia bellerica Roxb.

T. crenulata Roth.

(=T. tomentosa Cooke).

Anogeissus latifolia Wall.

Combretum extenbum Roxb.

Myrtaceae:

Eupenia jambolana Lamk.

Lythraceae:

Rotala tenuis Koehme.
(—Ammania tenuis Clarke).
Woodfordia fruticosa Kurz.
(=W. floribunda Salisb.)

(=W. floribunda Salisb.) Lagerstroemia parviflora Roxb.

Onagraceae:

Jussiaea suffruticosa Linn.

Cucurbitaceae:

Corallocarpus epigaeus C. B. Clarke.

Begoniaceae:

Begonia crenata Dryand.

Molluginaceae:

Mollugo pentaphylla Linn.

Umbelliferae:

Pimpinella monoica Dalz.

P. adscendens Dalz.

Heracleum concanense Dalz.

Rubiaceae:

Dentella repens Forst.

Mitragyna parviflora Korth.

Morinda tinctoria Roxb. Var. tomentosa Hook.

Hamiltonia suaveolens Roxb.

Borreria stricta Schum.

(=Spermacoce stricta Linn.)

Hymenodictyon excelsum Wall.

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Compositae:

Vicoa indica C. B. Clarke.
Ageratum conizoides Linn.
Blumea lacera DC.
B. membranaceae DC.
B. oxyodonta DC.
Xanthium strumarum Linn.
Sclerocarpus africanus Jacq.
Artemesia parviflora Buch-Ham.
Notonia grandiflora DC.
Senecio edgeworthii Hook.
S. grahami Hook. f.
Echinops echinatus Roxb.
Acanthospermum hispidum DC.
Parthenium hysterophorus Linn.

Lobeliaceae:

Lobelia alsinoides Lamk.

Campanulaceae:

Cephalostigma schimperi Hochst. C. flexuosum Hook.

Plumbaginaceae:

Plumbago zeylanica Linn,

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Myrsinaceae:

Embelia robusta Roxb.

Ebenaceae:

Diospyros melanoxylon Roxb.

Apocynaceae:

Carissa congesta Wight. (=C. carandas Graham). Holarrhena antidysentrica Wall. Wrightia tomentosa Roem.

Asclepiadaceae:

Pergularia daemia.
(=Daemia extensa R. Br.)
Holostemma annulares K. Sch.
(H. rheedianum Spreng.)
Cynanchum callialata Han.
Tylophora dalzellii Hook.
Sarcostemma intermedium Decne.
Marsdenia tenacissima Wight.
M. volubilis T. Cooke.
Ceropegia hirsuta W. and A.
Ceralluma fimbriata Wall.
Cryptostegia grandiflora R. Br.

Gentianaceae:

Canscora diffusa R. Br. Swertia minor T. Cooke.

Convolvulaceae:

Ipomoea calycina C. B. Clarke, I. muricata Jacq.

(=Calonyction muricatum Don.)

I. obscura Ker-Gawl.

I. batata Poir.

I. palmata Forsk.

I. coccinea Clarke.

Rivea hypocrateriformis Choisy.

Argyreia cuneata Ker-Gawl.

Jacquemontia paniculata Halsier.

Solanaceae:

Solanum indicum Linn.

Scrophulariaceae:

Verbascum coromandelianum Kuntz.
(=Celsia coromandeliana Vahl.)
Kickxia ramosissima Janchen.
(=Linaria ramosissima Well.)
Lindernia hissopiodes Hainer
Lindernia ciliata Pennell.
(Bonnaya brachiata Link.)
Striga gesnerioides Vatke.
(=S. orobanchioides Benth.)
S. densiflora Benth.
S. asiatica Kuntze.
(=S. lutea Lour.)
Rhampicarpa longiflora Benth.
Sopubia delphinifolia G. Don.

Centranthera nepalensis D. Don. (=C. hispida R. Br.)

Lentibulariaceae:

Urticularia flexuosa Vahl. U. uliginosa Vahl.

Bignoniaceae:

Dolichondrone falcata Seem. Heterophragma quadriloculare Schum. (H. roxburghii DC.)

Acanthaceae:

Dicliptera micrantha Nees.
Ruellia patula Jacq.
Andrographis echioides Nees.
Barleria prionitis Linn.
B. gibsoni Dalz.
Justicia quinqueengularis Koen.
Adhatoda vasica Nees.
Peristrophe bicalyculata Nees.

Verbenaceae:

Lantana camara Linn.
Var. aculeata Moldenke.
Tectona grandis Linn.
Gmelina arborea Roxb.
Vitex negundo Linn.
Clerodendron phlomidis Linn.
C. serratum Spreng.

Labiatae:

Ocimum canum Sims.
Coleus barbatus Benth.
Lavandula bipinnata O. Ktze.
(=L. burmanii Benth.)
Anisomeles malabarica R. Br.
Plectranthus mollis Sprang.
(=P. incanus Link.)
Leonotis neptifolia R. Br.

Amaranthaceae:

Amaranthus paniculatus Linn. Aerua lanata Juss.

Chenopidiaceae:

Chenopodium album Linn.

Polygonaceae:

Polygonum plebejum R. Br.

Loranthaceae:

Dendropthoe falcata Etting. (=Loranthus falcatus L nn.) Viscum angulatum Heyne. Taxilus cuneatus Spreng.

Santalaceae:

Santalum album Linn. Osyris wightiana Wall. (=0. arborae Wall.)

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Euphorbiaceae:

Euphorbia acaulis Roxb.

E. antiquorum Linn,

E. elegans Spreng.

Euphorbia hirta Linn.

(=E. pilulifera Hook.)

E. thymifolia Linn.

E. tirucalli Linn.

E. katrajensis Sant.

E. geniculata Orteg.

Givotia rottleriformis Griff.

Bridelia squamosa Greham.

Ulmaceae:

Holoptelea integrifolia Planch. *Trema orientalis* Blume.

Moraceae:

Ficus retusa Linn.

F. arnottiana Roxb.

Orchidaceae:

Habenaria rariflora A. Rich.

H. grandiflora Lindle.

H. longicalcarata A. Rich.

H. marginata Coleb.

H. cordifolia A. Rich.

Hypoxidaceae:

Hypoxis aurea Lour.

Curculigo orchioides Gaertn.

Dioscoreaceae:

Dioscorea pentaphylla Linn.

D. oppositifolia Linn.

Liliaceae:

Asparagus racemosus Willd.

Gloriosa superba Linn.

Iphigenia indica A. Gray.

I. pallida Baker,

Scilla indica Baker.

Urginea indica Kunth.

Dipcadi ursulae Blatter.

Chlorophytum laxum R. Dt.

C. tuberosum Baker.

C. orchidastrum Lind!.

Aloe vera Linn.

Smilacaceae:

Smilax zeyianica Linn.

Commelinaceae:

Cyanotis tuberosa Schull F.

C. cristata Schult F.

C. axillaris Schult F.

Murdania semiteres Santapau.

(=Aneilema semiteres Dalz.)

Araceae:

Arisaema murrayi Hook.

Colocasic esculenta Schott.

Cyperaceae:

Cyperus aristatus Roth.

C. brevifolius Hassk.

C. compressus Linn.

C. corymbosus Rottb.

C. difformis Link.

C. alsinoides Kunth. C. exaltatus Retz.

C. globosus Allion.

C. iria Linn.

C. michelianus Link.

C. pangori Rottb.

C. pumilus Linn.

C. rotundus Linn.

C. triceps Endl.

Fimbristylis tetragona R. Br.

F. woodrowii C. B. Clarke.

F. dichotoma Vahl.

F. ferruginea Vahl.

F. quinquangularis Kunth.

Eleocharis capitata R. Br.

Gramineae:

Apluda aristata L.

Andropogon pumilis Roxb. Aristida funiculata Trin.

A. reducta Stapf.

Arthraxon inermis Hook.

A. quartinianus Nash.

A. serrulatus Hoechst.

Arundinella tuberculata Munro.

Bothriochloa pertusa.

Bracharia isachne Stapf.

B. ramosa Stapf.

Chloris barbata SW.

C. virgata Swart.

Chrysopogon montanus Trin.

Cymbopogon martini Stapf.

Cynodon dactylon Pers.

Dactyloctenium aegyptiacum Willd.

Dendrocalamus strictus Nees.

Dicanthium annulatum Stapf.

D. caricosum A. Camus.

Digitaria marginata Link.

D. royleana Prain.

Dimeria ornithopoda Trin.

Dinebra retroflexa Panzer.

Echinochloa colonum Link.

E. crusgalli Beauv.

Eleusine indica Gaertn.

Elyonurus royleanus Nees.

Eragrostis charllis Hitch.

E. ciliansis Link.

E. diarrhena Steud.

E. minor Host.

E. pilosa Beauv.

E. tenuifolia Hochst.

E. uniloides Nees.

Eremopogon foveolatus Stapf.

Eulalia argentea Brongn. Hackelochloa granularis O. Kuntze. Heleochloa schoenoides Host. Heteropogon contortus Beauv. H. ritchiei Blatter and McC. H. triticeus Stapf. Isachne globosa O. Kuntze. I. pulchella Roth. Ischemum aristatum Linn. I. rugosum Salisb. *Iscilema authephoroides* Hook, Lophopogon tridentatus Hack. Melanocenchrus jacquemontii Jaub. (=Gracillea royleana Hook.) Microchloa indica Beauv. Nazia racemosa Kuntze. Ophiurus exaltatus O. Kuntze. Oplismensus burmanni P. Beauv. Oropetium thomaseum Trin. Panicum maximum Jacq. P. miliare Lamk. P. psilopodium Trin. Paspalidium flavidium A. Camus. P. punctatum A. Camus. Paspalum scorbiculatum Linn. Pennisetum alopeuros Nees. P. typhoideum Rich. Sehima nervosum Stapf. Setaria glauca Beauv. S. intermedia Haem. and Schult. S. verticilata Beauv. Sorghum purpurea-sericium. S. vulgare Pers. Sporobolus diander Beauv. Sporobolus indicus Br. सत्यमव जयत Thelepogon elegans Roth. Themeda quadrivalvis O. Kuntze. Trichotaena wightii Nees. Tripogon jacquemontii Stapf. Urochloa halopus Stapf. Pseudanthistiris heteroclita Hook. f. Tripogon bromoides Roth.

Pteridophyta:

Ophioglossaceae.
Ophioglossum aitchisoni d'Almeida.

Polypodiaceae:

Actinopteris dichotoma Bedd. Adiantum capillus-veneris Linn.

A. caudatum Linn.

A. lunulatum Burm.

Cheilanthes albo-marginata Clarke.

Lastrea crenata Bedd.

4.6. Flora at Purandar Fort:

Most of the forts in Desh are on hill crests above 2500'—3000'. They have preserved some original vegetation within their walls. The vegetation outside the walls, especially on the lower slopes was generally destroyed.

during wars in Maratha regime. This was followed by indiscriminate cutting. This is the reason why the hill forts of Torna, Sinhgad, Rajgad, Purandar, Lohgad, Shivaneri, Vishalgad, Panhala etc., look bleak and barren.

Vartak (1953, 1957) has described the flora of Torna, Sinhgad, Rajgad; Santapau (1947, 1957) of Purandar; Parandekar of Panhala, and of Harishchandragad by B. M. Wadhava etc. (1968). A general account of them is given by Santapau in Symposium on Decean Trap Country (Edited by Mahabale and published by National Academy of Sciences, New Delhi).

Purandar and its twin fort Vazirgad lie 4420' (1387 m) above M.S.L. and about 2500' (760 m). respectively above the surrounding plains. Their outer enclosing bastions are 150 m below the top. The N.C.C. Training camp for officers lies above the second enclave and the lower bastions.

The climate of the fort is bracing. The average rainfall is 44" or 109.4 cm for 15 years (1897-1911). Sometimes, as in 1943, it could be as high as 67.76" or 172 cm, or could be as low as 40-25" or 102.8 cm in 1935. Rainfa'l is maximum in July-August, about 80% of the total.

The temperature at afternoon varies generally from 20.8° C to 35.1°C, rarely as high as 37°.8°C (100°F) in May. December-January are the coldest, temperature reaching 10 C. or 50°F. Winds are not heavy. Weather from October is dry but very dry in summer; in monsoons it is humid. Humidity is never so low as in plains and nourishes the vegetation.

Vegetation: It is dry deciduous in general as will be seen from the list of plants appended below. On the lower slopes of the fort, there are tnickets of karvi (Carvia callosa), thorny bushes of Euphorbia neriifolia, Lantana camara, mixed with Hamiltonia suaveolens. Since the bushes and small trees on the lower slopes have been mostly cut down, only a few trees have survived. These are Anogeissus latifolia, Cipadessa fruticosa, Flacourtia indica, Lagerstroemia microcarpa, Dalbergia latifolia, Butea monosperma, Bauhinia racemosa, Bridelia squamosa Heterophragma quadrangulaire and sparsely distributed Tectona grandis, not very tall.

The whole vegetation has the appearance of a dry poor woodland or Savannah, turning into scrub. But the really interesting vegetation in the fort is at higher altitude above 3000'. It is encircled by bushes of Lasiosiphon eriocephalan, Lobelia nicotianaefolia, Peristrophe bicalvculata, Barleria prionitis, herbaceous plants of Senecio grahami. Pimpinella monoica etc. On the crest of the mountain during monsoons Thallictrum dalzellii, Impetiens dalzellii, Lepidagathis tricuspidata, Kicknixia ramosissima, Rheinwardia trigona, Oenothera rosea, Artemisia valgaris are abundant.

In monsoon ephemeral flora of legumes like Smithia sps., Delphinium dasycaulon, Curcuma psecudor ontana, Kalanchoe pinnata appears.

But in addition to these a rare Cactus-like looking world endemic Frerrea indica is found in the rocky ledges of Vazirgad. This plant as commented by Dr. T. S. Mahabale is confined to a very few places in the vicinity of Pune. Previously it was known only from Junnar fort, till McCann found its fallen twigs below the steep rocks at Kate's point at Mahabaleshwar. Ceropegia lawii is another interesting plant growing above 2000' but never below 1000'.

Several exotic trees have been planted inside the fort and on the higher plateaux e.g. Casuarina equisetifolia, Delonix regia, Celastrus glomeratus, Veronica angellis. Some of the plants are escaped from the garden, and are of European origin. The list below does not include these, nor the commonplace ones. It gives only important plants from Santapau's list.

Monsoon ephemeral plants are also the same as elsewhere, where rainfall is not heavy as in Lonavala. They disappear by November but are nighly picturesque in monsoon after August. In the dry streams at the base of the fort Ophiolgossum reticulatum grows. On lower slopes O. gramineum is also found. The water tanks in Vazirgad abound in Volvox and liverworts on rocks

Important Plants from Flora of Purandar after Santapau (1947)

Ranunculaceae:

Clematis triloba Heyne ex Roth. Clematis gouriana Roxb. Clematis hedysarifolia DC. Delphinium dasycaulon Fres. Thalictrum dalzellii Hook.

Magnoliaceae:

Michelia champaca Linn.

Menispermaceae:

Cocculus hirsutus (Linn.) Diels. Cocculus pendulus Diels.

Cruciferae:

Rorippa indica (Linn.) Hoechreut. Cardamine trichocarpa Hoechst.

Capparidaceae:

Cleome simplicifolia (Camb.) Hook f. and Thoms. Gynandropsis gynandra (Linn.) Briq.

Flacourtiaceae:

Flacourtia indica Merr.

Polygalaceae:

Polygala persicariaefolia DC. Polygala chinensis Linn.

Caryophyllaceae:

Saponaria raccaria Linn. Cerastium glomeratum Thuill. Polycarpaea corymbosa Lamk.

Portulacaceae:

Talinum cuneifolium Willd.

Malvaceac:

Kydia calycina Roxb.
Sida rhombifollia Linn.
Abutilon polyandrum (Roxb.) Wt. and Arn.
Hibiscus trigonum Linn.
Hibiscus solandra L'Herit.
Abelmoschus manihot (Linn.) Medik.

Bombacaceae:

Salmalia malabarica (DC.) Schott. and Endl.

Sterculiaceae:

Eriolaena quinquelocularis Wight.

Tiliaceae:

Grewia tilaefolia Vahl.

Triumfetta rotundifolia Limk.

Corchorus trilocularis Linn.

Linaceae:

Linum mysorense Heyne.

Reinwardtia trigyna (Roxb.) Planch.

Malpighiaceae:

Hiptage bengalensis (Linn.) Kurz.

Aspidopteris cordata (Heyne) A. Juss.

Geraniaceae:

Geranium ocellatum Camb. var. himalaicum (Kunth) Engler

Oxalidaceae:

Biophytum sensitivum (Linn.) DC.

Balsaminaceae:

Impatiens balsamina Linn, var. rosea Hook f. Impatiens dalzellii Hook, f. and Thoms. Impatiens oppositifolia Linn. Impatiens Sp.

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Burseraceae:

Garuga pinnata Roxb.

Meliaceae:

Soymida febrifuga (Roxb.) A. Juss. Toona ciliata Roem.

Celastraceae:

Celastrus paniculata Willd. Gymnosporia spinosa Fiori.

Rhamanaceae:

Zizyphus glaberrima Santapau. Zizyphus rugosa Lamk. Rhamnus trique ster (Wall.) Laws. Colubrina asiatica (Linn.) Brogn.

Vitaceae:

Cissus woodrowii Santapau. Cissus elongata Roxb. Cissus repanda Vahl. Leea robusta Roxb. Hort. Beng. Leea edgeworthii Santapau.

Papilionaceae:

Heylandica latebrosa DC.
Crotalaria filipes Benth.
Crotalaria filipes var. trichophora Cooke.
Crotalaria calycina Schrad.
Crotalaria medicaginea Lamk.
Crotalaria orixensis Willd.

Indigofera glandulosa Willd.

Indigofera hendecaphylla Jacq.

Indigofera tinctoria Linn.

Psoralea corylifolia Linn.

Sesbania sesban var. picta Santapau.

Smithia conferta Sm.

Smithia setulosa Dalz.

Smithia bigemina Dalz.

Alysicarpus tetragonolobus Edgq. Alysicarpus vaginalis (Linn.) DC.

Alysicarpus belgaumensis WT.

Alysicarpus beigaumensis W 1.

Alysicarpus belgaumensis var. racemosus Baker.

Desmodium triflorum (Linn.) DC.

Desmodium parviflorum (Dalz.) Baker.

Teramnus labialis (Linn. f.) Spreng.

Mucuna prurita Hook.

Butea monosperma (Lamk.) Taubert.

Canavalia glandiata (Jacq.) DC.

Phaseolus khandalensis Santapau.

Phaseolus aconitifolus Jacq.

Phaseolus dalzellii Cooke.

Dolichos bracteatus Baker (in Hook f. FL Brit.)

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Atylosia sericea Benth.

Atylosia scarabaeoides (Linn.) Benth.

Rhynchosia minima (Linn.) DC.

Cylista scariosa Roxb.

Moghania strobilifera (Linn.) St. Hil

Dalbergia latifolia Roxb.

Dalbergia lanceolaris Linn. f.

Pongamina pinnata (Linn.) Pierre

Caesalpiniaceae:

Caesalpinia sappan Linn.

Cassia fistula Linn.

Cassia sophera Linn.

Bauhinia purpurea Linn.

Bauhinia racemosa Lamk.

Sonchus asper (Linn.) Hill.

Sonchus arvensis Linn.

Lannaea nudicaulis Hook. f.

Cichorium intybus Linn.

Lobeliaceae:

Lobelia heyneana Roem. et Schult.

Campanulaceae:

Campanula alphonsii Wall. ex. DC.

Campanula canescens Wall. ex. DC.

Campanula ramulosa Wall. ex. Roxb.

Plumbaginaceae:

Plumbago zeylanica Linn.

Sapotaceae:

Mimusops elengi Linn.

Ebenaceae:

Diospyros montana Roxb.

Oleaceae:

Nyctanthes arbor-tristis Linn.

Apocynaceae:

Carissa congesta Wt. Lochnera rosea (Linn.) Reich. Wrightia tinctoria R. Br.

Asclepidaceae:

Hemidensmus indicus (Linn.) R. Br. Cryptolepis buchanani Roem. Scultz. Cyanchum callialata Ham. Gymnema sylvestris (Retz.) R. Br. Tylophora dalzellii Hook. f. Pergularia daemia (Forsk.) et. MeC. Marsdenia volubilis Cooke. Ceropegia lawii Hook. f. Ceropegia evansii McCann. Ceropegia aculeata Hook. Frerrea indica Dalz.

Loganiaceae:

Budellia asiatica Lour.

Gentianaceae:

Exacum pedunculatum Linn,
Exacum pumilum Griseb.
Exacum lawii Clarke
Centaurium roxburghii (Don) Druce.
Canscora diffusa R. Br.
Canscora pauciflora Dalz.
Swertia minor Forst, f.

Boraginaceae:

Cynoglossum wallichii G. Don, Gen. Syst. Adelocaryum coelestinum (Lindl.) Brand.

Convolvulaceae:

Porana malabarica Clarke. Evolvulus alsinoides Linn. Convolvulus arvensis Linn. Ipomoea ericcarpa R. Br. Prodr. Ipomoea nil (Linn.) Roth Argyreia setosa (Roxb.) Choisy.

Solanaceae:

Solanum indicum Linn.

Scrophulariaceae:

Kickxia ramosissima (Wall.) Janchen.
Kickxia incana (Wall.) Pennell.
Dopatrium junceum (Roxb.) Buch. Ham.
Lindernia parviflora (Roxb.) Haines.
Lindernia sessiliflora (Benth.) Wettst.
Sutera dissecta Walp, Santapau.
Stemodia viscosa Roxb.
Buchnera bispida Buch. Ham.
Striga gesneroides (Willd.) Vatke.
Striga densiflora Benth.

Mimosaceae:

Leucaena glauca (Linn.) Benth. Mimosa pudica Linn. Mimosa hamata Willd. Acacia arabica Willd.
Acacia farnesiana Willd.
Acacia tomentosa Willd.
Acacia torta Graib.
Acacia pennata (Linn.) Willd.

Crassulaceae:

Kalanchoe olivacea Dalz.

Combretaceae:

Terminalia crenulata Roth. Terminalia chebula Retz.

Myrtaceae:

Syzygium cumini (Linn.) Skeels.

Lythraceae:

Rotala densiflora (Roth) Koehne, Rotala tenuis (W.T.) Koehne, Ammannia multiflora Roxb, Ammannia baccifera Linn, Woodfordia fruticosa (Linn.) Kurz.

Onagraceae:

Oenothera rosea Ait.

Cucurbitaceae:

Melothria maderaspatana (Linn.) Cogn, Dicoelospermum ritchiei Clarke,

Molluginaceae:

Glinus lotoides Linn.

Apiaceae:

Centella asiatica (Linn.) Urb.
Trachispermum stictocarpum Wolff var. typicum Wolff.
Pimpinella tomentosa Dalz.
Pimpinella monoica Dalz.
Heracleum concanense Dalz.

Rubiaceae:

Pavetta indica Linn. Hamiltonia suaveolens Roxb. Borreria stricta (Linn, f.) Schum. Rubia cordifolia Linn.

Compositae:

Centratherum tenue (Wt.) Clarke. Centratherum hookeri Clarke. Vernonia cinerea (Linn.) Less. Vernonia divergens (Roxb.) Edgew. Ageratum conyzoides Linn. Cyathocline purpurea (Don) O. Kuntze. Conyza viscidula Wall. Ex DC. Blumea eriantha DC. Blumea lacera DC. Blumea malcolmii (Clarke) Hook. f. Blumea membranacea DC. Blumea oxyodonta DC. Blumea mollis (Don) Merr. Pluchea tomentosa DC. Sphaeranthus indicus Linn. Gnaphalium luteo-album Linn.

Gnaphalium pulvinatum Del. Siegesbeckia orientalis Linn. Blainvillea latifolia (Linn. f.) DC. Artemisia parviflora Buch. Ham. Artemisia nilgirica (Clarke) Pamp. Gynura angulosa DC. Notonia grandiflora DC. Senecio hiwrensis (Dalz.) Hook. f. Senecio edgworthii Hook. f. Senecio grahami Hook. f. Senecio belgaumensis (Wt.) Clarke. Senecio gibsoni Hook. f. Volutarella ramosa (Roxb.) Santapau. Sonchus oleraceus Linn. Rhamphicarpa longiflora (Arn.) Benth. Sopubia trifida Buch. Ham. Lindenbergia indica (Linn.) O. Kuntze.

Orobanchaceae:

Christisonia lawii Wt. on Carvia callosa.

Lentibulariaceae:

Utricularia striatula Sm.

Bignoniaceae:

Heterophragma quadriloculare (Roxb.) Schum.

Acahthaceae:

Hemigraphis latebrosa Nees var. heyneana Bremek. Dyschoriste dalzellii (Anders) O. Kuntze. Eranthe mum roseum (Vahl) R. Br. Carvia callosa (Wall.) Bremek. Thelepaepale ixiocephala (Benth.) Bremek. Andrographis echioides (Linn.) Nees. Haplanthus verticillatus (Roxb.) Nees. Barleria prionitis Linn. Asystasia dalzelliana Santapau. Lepidagathis mitis Dalz. Lepidagathis cuspidata (Wall.) Nees. Rungia pectinata (Linn.) Nees. Dicliptera micranthes Nees. Dicliptera zeylanica Nees. Justicia betonica Linn. Justicia diffusa Willd. Justicia quinqueangularis Koen. Justicia simplex D. Don. Justicia micrantha Heyne, Adhatoda vasica Nees Rhinacanthus nasuta (Linn.) Kurz.

Verbenaceae:

Lantana camara Linn. var. aculeata (Linn.) Mold. Tectona grandis Linn. f. Phyla nodiflora (Linn.) Green.

Lamiaceae (LABIATAE):

Ocimum americanum Linn.

Plectranthus costata Bach-Ham.

Plectranthus mollis (Ait.) Spreng.

Peristrophe bicalyculata (Retz.) Nees.

Plectranthus stocksii Hook, f. Coleus forskohlii (Poir.) Briq. Anisochilus carnosus (Linn.) Wall. Anisochilus verticillatus Hook. f. Lavandula perrottetii Benth. Lavandula bipinnata var. rothiana O. Kuntze Pogostemon plectranthoides Desf. Pogoste mon parviflorus Benth. Colebrookea oppositifolia Smith. Anisomeles malabarica R. Br. Anisomeles heyneana Benth. Leucas stelligera Wall. Leucas lavandulaefolia Nees. Leucas biflora R. Br. Leucas montana Spreng. Nepeta hindustana Haines var. woodrowii (Cooke) Santapau.

Nyctaginaceae:

Boerhaavia repanda Willd.

Amarantaceae:

Aerua sanguinolenta (Linn.) Blume

Polygonaceae:

Polygonum plebjeum R. Br. Polygonum glabrum Willd. Polygonum nepalense Meisn.

Piperaceae:

Peperomia pellucida (Linn.) H. B. K.

Proteaceae:

Grevillea robusta A. Cunn. (Planted)

Thymeleaceae:

Lasiosiphon eriocephalus Decne.

Loranthaceae:

Dendrophthoe falcata (Linn, f.) Etting, Scurrula philippinensis (Cham. et. Schl.) D. Don, Taxillus cuneatus (Roth) Danser.

Santalaceae:

Osyris wightiana Wall.

Euphorbiaceae:

Euphorbia fusiformis Buch. Ham. Bridelia squamosa Gehrm. Emblica officinalis Gaertn. Phyllanthus maderaspatensis Linn. Securinega virosa (Oxb.) Pax et Hoffm. Mallotus philippinesis Mull. Arg. Acalypha malabarica Muell. Arg.

Urticaceae:

Urficaceae.
Trema orientalis (Linn.) Blume.
Fleurya interrupta (Linn.) Gaud.
Girardinia zeylanica Deene.

Moraceae:

Ficus nervosa Heyne.
Ficus heterophylla Linn. f.
Ficus arnottiana Miq.
Ficus arnottiana var. courtallensis King.

Orchidaceae:

Dendrobium microbulbon Rich. Dendrobium mabelae Gammie. Dendrobium barbatulum Lindl. Eulophia ochreata Lindl. Aerides maculosum Lindl. Peristylus stocksii (Hook. f.) Kranz. Habenaria hollandiana Santapau. Habenaria crassifolia Rich. Habenaria digitata Lindl. Habenaria gibsoni Hook. f. Habenaria grandiflora Lindl. Habenaria grandifloriformis Blatt. et McCann. *Habenaria hevneana* Lindl. Habenaria longicalcarata Rich. Habenaria marginata Coleb. Habenaria rariflora Rich. Bervilia aragoana Gand.

Zingiberaceae:

Hitchenia caulina (Graham) Baker, Curcuma pseudomontana Graham. Zingiber macrostachyum Dalz.

Musaceae:

Ensete superbum (Roxb.) Cheesm.

Hypoxidaceae:

Hypoxis aurea Lour. Curculigo orchioides Gaertn.

Amaryllidaceae:

Pancratium parvum Dalz. Pancratium Sp.

Dioscoreaceae:

Dioscorea pentaphylla Linn. Dioscorea bulbifera Linn.

Liliaceae:

Asparagus racemousus var. javanica Baker. Gloriosa superba Linn.
Iphigenia pallida Baker.
Scilla hyacinthina (Roth) MacBride.
Urginea indica (Roxb.) Kunth.
Chlorophytum tube rosum (Roxb.) Baker.
Aloe variegata Linn.

Commelinaceae:

Murdannia semiteres Santapau. Cyanotis tuberosa (Roxb.) Schult. f. Cyanotis fasciculata Schult. f. Cyanotis cristata (Linn.) Schult. Cyanotis axillaris (Linn.) Schult. f.

Araceae:

Arisaema murrayi (Grah.) Hook. Arisaema neglectum Schott. Arisaema tortuosum (Wall.) Schott. Sauromatum guttatum (Wall.) Schott.

Eriocaulaceae:

Eriocaulon nepalense Presc.

4.7: Flora of Khandala:

Khandala is a well-known hill station on the Central Railway, 116 km. from Bombay and 66 km. from Pune. It stands at an elevation of 677 m. above the mean sea level and 630 m. above Konkan plains to the West. The northern portion, Kune plateau, is above the St. Mary's stream and ravine, but the highest part at Khandala is the Bhoma Hills, 2781' or 848 m. above the sea level. The Echo point is a little below, 722 m. high. The Dake's Nose is a well-known feature of a massive hill. To the north of Khandala lies the Behram plateau. It ends abruptly on all sides. In the distant geological times this plateau was continuous with that of Matheran 18 km. away to N-NW, connected with the main Deccan plateau. The tops of both are nearly at the same height and have similar flora. St. Xavier's Ravine runs S to SW direction 3 km. long, and then goes into the valley below Rajmachi Hill.

Chimate: Khandala being at the edge of the Ghats, gets maximum It begins towards the end of May or beginning of June and lasts till early September with occasional breaks in August. Winds run The return monsoon is not very significant. The rainfall is NW-SE. so heavy that it could be 335 mm in a day some times. Total rainfall for 1952 was very low 90" or 228.60 cm. Average for 16 years is 193" approx. Due to torential rains, the top soil in many parts of Khandala is completely washed off and hence the vegetation gets deforested. Only low grade cereals like Eleusine coracana or Nachni grow here. Due to washing away the soil, rocks get denuded and lie bare open. number of rainy days varies from 96 to 112. Winds in monsoon blow 60 km. per hour SW-NE. In other seasons they are not so strong and blow N-NE. The relative humidity is 90 per cent in early mornings even in the driest months. It is reduced to 70 per cent in hot season and to 25 per cent in afternoon. The maximum temperature is 37°.8 C or 100°F in summer in April-May, which are the hottest months and 21°.1C or 70°F in early rainy days. The lowest temperature is generally in December-January, 14°.5C.

Soils: The hills being volcanic in origin, soils are derived from basalt. They are under the influence of heavy rains, which do not allow them to mature. At Bhoma Hills, Echo Point, Behram plateau they are red to deep black cotton soils but nowhere they are similar. In other places they are of intermediate colour.

Many renowned botanists had explored this place botanically since long. Among them may be mentioned John Graham (1805—1839), Blatter and Hallberg, McCann, Santapau (1947). A number of distinguished botanists are mentioned by Cooke (1901—1908) in his introduction to his Flora of the Bombay Presidency, who have collected plants at Lonavala and Khandala. Notable among them are Law, Stocks, Woodrow, Cooke himself, Sedgewick, Bhide, Bhiva, Kanitkar, McCann, etc.

Vegetation: Evergreen Forests: At Behram plains in the Bor Ghat, there are no deciduous trees except on the top of that plain. The habit of shedding leaves is not uniform due to high humidity throughout the year. There are also several evergreen trees, although some of them shed their leaves in the rainy season. The top layer canopy at Meroli Plateau consists of Caryota urens, Ficus nervosa, F. racemosa, Schleichera cleosa, Madhuca indica, Tetrameles nudiflora, Dysoxylon binectariferum, Alstonia scholaris, Albizzia procera, Holigarna grahami, mixed with Combretum ovalifolium, Diploclisiaglaucesens, Entada pursaetha, Calycopteris floribunda. On the edges of the Meroli Plateau, away from the Ravine, some well-developed large trees of Garcinia talboti, Lepi santhes tetraphylla, Lagerstroemia lanceolata are found mixed with climbers like Anodendron paniculatum, Symphorema involucratum,

The second layer has Hymenodictyon obovatum, Gmelina arborea, Sterculia guttata, Erinocarpus nimmonii, Mammea surirega, Syzygium cumini, Miliusa tomentosa and shrubs of Glycosmis mauritiana, Carissa congesta, followed by broad-leaved grasses like Oplismenus compositus, Piper nigrum, and Gnetum ula. There is not much of green vegetation due to soil erosion, but on the rocks and tree trunks, and in the crevices of slopes where soil has been preserved, monsoon ephemerals of Impatiens, members of Zingiberaceae, Costus speciosus appear. The important places for collection at Khandala are: (1) Meroli Plateau, (2) Bhoma Hills, (3) River, (4) St. Xavier's Ravine, (5) Kune Plateau, (6) Elphinstone slopes, (7) Old Khandala Road and Rai Wood or Devrai near Lonavala station on old Khandala Road.

Other important localities are (1) St. Xavier's Ravine, (2) Duke'. Nose Ravine. Here the vegetation is similar to that of Meroli Plateau but the trees are not massive. The moist deciduous plants like Bombax insigne, Mimusops elengi get mixed up with Sageraea laurifolia, Terminalia chebula and bushes of Haplanthus verticillatus, Neuracanthus trinervius, Woody lianas like Bauhinia vahlii, Butea superba (Butea parviflora), Gnetum ula, Strychnos colubrina, Anodendron paniculatum and woody species of Ampelidaceae (Vitaceae), climbers like Capparis moonii, Elaeagnus conferta are seen and large stands of Strobilanthes callosus, S. ixiocephalus, S. perfoliatus are very common. On the open slopes of ravine Ensete superbum is noticeable, often growing in precarious positions. The vegetation is of semi-evergreen type and uniform. At the bottom of the ravine along the stream Bambusa arundinacea is abundant.

The third important locality for plants is Bhoma Hills. On its top, plants like Terminalia chebula, T. bellerica, T. crenulata, Bridelia squamosa, Crotalaria retusa, Glochidion hohenackeri, Sterculia guttata, Diospyros montana, Actinodaphne angustifolia, Bombax insigne, Dillenia pentagyna, Celastrus paniculata dominate the scenery. Lobelia nicotianaefolia, Kydia calycina, Pittospermum floribundum, Walsura trijuga, Cordia obliqua Rauvolfia densiflora are also found but are rare. Among the climbers Smilax zeylanica, Entada pursaetha, Olax wightiana, Clematis hedysarifolia are noteworthy. Vitex negundo, Lantana camara, Stachytarpheta jamaicensis appear to have been naturalized. Asclepias curasavica has spread up to Fourbay. Carvia callosa, Euphorbia neriifolia form undergrowth on Behram plateau. There are many evergreen species such as Sapium insigne var. malabaricum, Ixora brachiata, Hymenodictyon obovatum, Careya arborea, Cassia fistula, Sterculia guttata, Asparagus racemosus var. javanicus, Smilax zeylanica. Ventilago

madaraspatana etc. The vegetation appears to be transitional and presents different aspects. It changes according to seasons. In summer, they look dry, but towards the end of rainy season and each winter it gets changed due to large plants of Senecio grahami, Neuracanthus sphaerostachys, Dysophylla stellata. In marshy places Hygrophila serpyllum var. hookeriana, Utricularia sp., Striga gesneroides var. minor Blumea oxyodonta are seen sometimes; but with approaching summer season, most of these plants and grass die, and only the trees of Terminalia crenulata, Memecylon umbellatum flower, or they may be without flowers. Trees of Terminalia crenulata get fully covered with orchids like Dendrobium barbatulum, Eria dalzelli, Aerides crispum.

On Kune and Khandala plateaus several plants of Peltophorum feruginosum, Pterocarpus marsupium, Delonix regia etc. are cultivated. Garden plants such as Syzygium jambos are introduced and grow side by side with naturally growing Cassia fistula, Firmiania colorata, Opiuntia etator.

There is a rich herbaceous vegetation also, composed of Salvia plebeia, Colebrookea oppositifolia, Pogostemon bengalense, Leucas stelligera. They are transitional climax of seasonal vegetation here.

On the Elphinstone Road below the Elphinstone Point one sees Atlantia racemosa, so common at Bhimashankar and on Junnar Hills. Putranjiva roxbourghii, Tetrameles nudiflora, Ventilago bombaiensis form rich semi-evergreen vegetation if left undisturbed. They all resemble the vegetation at Meroli Plateau, but as we come towards Lonavala, they get mixed with drier species.

Monsoon Ephemerals: The most remarkable feature of the vegetation at Khandala and Lonavala are the monsoon ephemerals. They begin to appear soon after the first rains and come to high pitch from August to October. Soon after rains Pancratium sp., Curculigo orchioides, Curcuma pseudomontana, Arisaema murrayi appear; but the most spectacular are Impatiens kleineii, Hypoxis aurea, elongata, Tylophora fasciculata, Fimbristylis digitata, Ensete superbum. New grasses begin to appear within about 10 days after rains. Cyperus rotundus, Exacum pumilum, Ceropegia attenuata; Impatiens balsamina grow fast with Chlorophytum glaucum, C. tuberosum, Begonia crenata. Barleria prattensis. Six species of ground chids Habenaria, Orchids H.rariflora, H. ordigitata, H. heyneana, H. grandiflora, H. longicorniculata, H. marginata, Platanthera sussanae add beauty to land scape. In the middle of the rainy season several Compositae, herbaceous Rubiaceae like Anotis foetida, Drosera indica, Spermacoce cinearis, Smithia sensitiva, Elephantopus scaber, Cyanotis tuberosum, Senecio grahami, Clerodendron sub-serratum, Geissospis eristata appear in large numbers. In isolated corners Oroxylum indicum, Begonia concanensis, Exacum bicolor, Kaemphera scaposa, Rhynchoglossum oblongum var. parvi-florum, Sonerila seapigera, Impatiens acaulis, Ceropegia evansii, Leea robusta, L. setuligera appear prominent. It is a remarkable sight to watch these monsoon ephemerals grow and bloom gregariously. They completely disappear soon after the onset of winter.

On the whole, the vegetation in the ravines and on the sunny slopes is of the evergreen or semi-evergreen type, and places where water gets retained, it is of the moist deciduous type slowly changing to transitional vegetation which is a mixture of moist and dry species. The monsoon ephemeral flora at Lonavala and Khandala is very remarkable and lasts

tiil October end. Many tuberous and rhizomatous plants are seen during rainy season and last throughout by underground parts, but their aerial parts all disappear in summer. The monsoon ephemeral flora on the hill tops contains both temperate herbaceous plants and recently arrived grasses, Compositae, herbaceous Begoniaceae and Rubiaceae. There are a large number of cultivated plants, both trees and shrubs, and herbs at Khandala and Lonavala introduced by foreigners who used to stay here, and by the members of the St. Xavier's Villa.

There is also a remarkable group of evergreen trees like Holigams grahami and climbers like Entada pursaetha, Gnetum ula in a place like Deorai wood near Lonavala station. They are relict types.

Vegetation of Khandala tends to become woodland savannah towards Talegaon and merges with open grasslands.

The following are some of the important plants found at Khandala:

- 1. Several species of ground and epiphytic orchids.
- 2. Drosera indica a small insectivorous plant on Sakharpathar.
- 3. Hymenodictyon excelsum, Actinodaphne hookeri, Bixa orellena.
- 4. Aqueous plants Hygrorhiiza aristata Dysophylla stellata, Blysa found in Khandala lake.
- 5. Climbers Entada pursaetha, Gnetum ula, Eraeodendron glaucum are huge lianas not to be seen elsewhere.
- 6. Several species of Balsams, ferns both on the ground and on tress epiphytic Lycopodium hamiltoni growing at great heights on tall trees in Rai wood, several mosses; Psilotum nudum growing epiphytically; Isoetes coromandelina; Ophioglossum fibrosum and O. nudicaule, O. gramineum and several species of liverworts and fungi are found here.

A considerable part of vegetation of Khandala is destroyed by man and even by hundreds of students and botanists visiting the place. They collect common and rare plants by gunny bags and throw away afterwards. This is the most destructive practice from the point of vegetation. The more important plants enlisted above will show how rich is the vegetation here. For further details see Santapau's Flora of Khandala, (1947).

List of Selected Important Plants of Khandala And Lonawala (after Santapau, 1947).

DICOTYLEDONS—

Ranunculaceae:

Clematis gouriana Roxb. ex DC.

C. hedysarifolia DC.

Delphinium dasycaulon Fres. Mus. Senckenb.

Dilleniaceae:

Dillenia pentagyna Roxb.

Anonaceae:

Miliusa tomentosa Roxb.
Sageraea laurifolia (Grah.) Blatter.

Menispermaceae:

Diploclista glaucescens Blume Stephania japonica Thumb. Cocculus hirsutus Linn. Cissampelos pereira Linn. Cyclea burmanni DC.

Cruciferae (Brassicaceae):

Cardaminne trichocarpa Hoechest.

Capparidaceae:

C. separia Linn. Capparis moonii Wight C. zeylanica Linn.

Flacourtiaceae:

Flacourtia montana Graham. F. indica Burm. f.

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Pittosporaceae:

Pittosporum floribundum Wight

Caryophyllaceae:

Vaccaria pyramidata Medik,

Elatinaceae:

Burgia ammanioides Roxb. ex Roth

Gutiferae:

Garcinia indica (Du Pett) Thom.
G. spicata (Wight and Arn.) Hook, f.
G. tulboti Raizada ex Santapau
Mammea suriga (Buch-Ham. ex. Roxb.) Koester.

Malvaceae:

Sida rhombifolia Linn. var. retusa Masters S. rhombifolia Linn. var. rhomboidea Masters Kydia calycina Roxb.
Abutilon polyandrum Schlecht.
Urena lobata Linn.
Abelmoschus manihot Linn.
A. esculentus Linn.
Azanza lampas Cav.

Bombacaceae:

Bombax ceiba Linn. B. insigne Wall.

Sterculiaceae:

Sterculia urens Roxb.
S. villosa Roxb.
S. guttata Roxb.
Firmiana colorata R. Br.
Pterospermum acerifolium Willd.

Elaeocarpaceae:

Elaeocarpus sphaericus (Garetn.) Schumann

Linaceae:

Reinwardtia trigyna (Roxb.) Planch.

Malphigiaceae:

Hiptage benghalensis (Linn.) Kurz Aspidopterys indica (Roxb.) Hoechest A. cordata (Heyne) A. Juss.

Balsaminaceae:

Impatiens acaulis Arn.

I. oppositifolia Linn.

I. kleinii Wight & Arn.

I. kalsamina Linn.

I. balsamina Linn. var. rosea Hook. f.

I. balsamina Linn. var. corymbosa Santapau

Rutaceae:

Evodia lunulatum (Gaertn.) Merrill.

Fagara budrunga Roxb.

Toddalia asiatica (Linn.) Lamk.

Glycosmis mauritiana (Lamk.) Tanaka.

Murraya koenigii (Linn.) Spreng.

Atalantia monophylla (Roxb.) DC.

A. racemosa Wight and Arn.

Burseraceae:

Garuga pinnata Roxb.

Meliaceae:

Turraea villosa Benth.

Disoxylon binectariferum (Roxb.)

Amoora lawii (Wight ex Bedd.) Hook, f.

Walsura trijuga (Roxb.) Kurz.

Olax wightiana Wall. ex. Wight and Arn.

Opiliaceae:

Cansjera rheedii Gmel.

Icacinaceae:

Nothopodytes foetida (Wt.) Sleumer

Hippocrateaceae:

Reissantia arahamii (Wt.) Ding Hou Salacia prinoides DC.

Celastraceae:

Celastrus paniculata Willd.

Gymnosporia rothiana Wight and Arn.

Elaeodendron roxburghii Wight, and Arn.

Rhamnaceae:

Ventilago bombaiensis Dalx.

V. madaspatna Gaertn. var. ructiflida Santapau

Zizvphus horridra Roth.

Z. glaberrima Santapau

Scutia circumcissa (Linn. f.) Druce

Vitaceae:

Ameocissus latifolia (Roxb.) Planch.

Cissus discolor Blume

Cissus repanda Vahl.

C. woodrowii (Stapf) Santapau

Tetrastigma canarense (Dalz.) Gamble

Leea robusta Roxb.

L. indica (Brum.) Merrill

L. setuligera Clarke

Anacardiaceae:

Iannea coromandelica (Houch.) Merrill Holigarna grahami (Wight) Hook. f. Semecarpus anacardium Linn. Papilionaceae:

Heylandia latibrosa DC.

Crotalaria mysorensis Roth.

C. triquetra Dalz.

C. albida Heyne ex Roth.

C. nana Burm.

C. retusa Linn.

Melilotus indica All.

Tephrosia tinctoria Pers.

T. canarensis J. R. Drumnond

Sesbania bispinosa (Jacq.) Fawcett and Rendle

Geissaspis cristata Wight and Arn.

G. tenella Benth.

Simithia sensitiva var. flava (Dalx.) Cooke

S. conferta Sm.

S. purpurea Hook.

S. setulosa Dalz.

Alysicarpus vaginalis

A. glumaceus (Vahl.) DC.

A. belgaumensis Wight

Desmodium laxiflorum DC.

D. gangeticum (Linn.) DC.

D. rotundifolium Baker

D. alysicarpoides Knapp van Meeuwen

Teramnus labialis (Linn. f.) Spreng.

Mucuna prurita Hook.

Erythrina stricta Roxb.

Butea parviflora Roxb.

B. monosperma (Lamk.) Taub.

B. monosperma var. lutea Mahesh.

B. superba Roxb.

Canavalia stocksii Dalz.

Pueraria tuberosa (Roxb.) DC.

Phaseolus khandalensis Santapau

P. dalzellii Cooke

Vigna capensis Walp.

Dolichos falcatus Klein ex Willd.

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Atylosia sericea Benth.

A. lineata Wight and Arn.

Cylista acariosa Roxb.

Moghania strobilifera Linn.

M. gracilis Mukerjee

Dalbergia latifolia Roxb.

D. sympathetica Nimmo ex Graham

Derris scandens (Roxb.) Benth.

Caesalpinaceae:

Cassia fistula Linn.

C. absus Linn.

Bauhinia racemosa Lamk.

B. malabarica Roxb.

B. vahlii Wight and Arn.

B. purpurea Linn.

Mimosaceae:

Entada pursaetha DC. Acacia torta (Roxb.) Craib

Rosaceae:

Pygeum gardneri Hook, f.

Droseraceae:

Drosera indica Linn.

Haloragaceae:

Myriophyllum spathulatum Blatt. and Hallb.

Rhizophoraceae:

Carallia brachiata (Lour.) Merrill

Combretaceae:

Terminalia bellerica (Gaertn.) Roxb.

T. chebula Retz.

T. crenulata Roth.

Calycopteris floribunda (Roxb.)

Anogeissus latifolia (Bedd.) Lamk.

Combretum ovalifolium Roxb.

C. latifolium Blume

Myrtaceae:

Syzygium cumini (Linn.) Skeels

Lecythidaceae:

Careya arborea Roxb.

Melastomaceae:

Osbeckia truncata Don Sonerila scapigera Hook.

Memecylon umbellatum Burm.

M. umbellatum var. capitellatum Cooke

M. talbotianum Brandis

Lythraceae:

Ammania multiflora Roxb.

A. baccifera Linn.

A. senegalensis Lamk.

Rotala indica (Willd.) Kochne

R. serpyllifolia (Roth) Bremek.

Woodfordia fruticosa (Linn.) Kurz.

Lagerstroemia parviflora Roxb.

L. lanceolata Wall. ex Wight and Arn.

Onagraceae:

Ludwigia octovalvis Subsp. sessiliflora (Micheli) Raven

Samydaceae:

Casearia graveolens Dalx.

Begoniaceae:

Begonia crenata Dryad

B. concanensis DC.

Tetramelaceae:

Tetrameles nudiflora R. Br.

Apiaceae:

Centella asiatica (Linn.) Urban.

Pimpinella heyneana Wall.

P. adscendes Dalz.

P. multiradiata Santapau

Heracleum sprengelianum Wight and Arn.

H. concanense Dalz.

Rubiaceae:

Adina cordifolia (Roxb.) Hook f.

Mitragyna parviflora (Roxb.) Korth.

Hymenodictyon excelsum (Roxb.) Wall.

H. obovatum Wall.

Wendlandia heynei (R. and S.) Santapau and Merchant

Oldenlandia corymbosa Linn.

O. maheshwarii Santapau and Merchant

Anotis lancifolia (Dalz.) Hook f.

Mussaenda glabrata (Hook, f.) Hutch.

Xeromphis spinosa (Thumb.) Keay.

Gardenia resinifera Roth.

Ixora arborea Roxb. ex Sm.

I. nigricans R. Br. ex Wight and Arn.

Pavetta concanica Bremek.

P. crassicaulis Dremek.

P. tomentosa Roxb, ex Rees.

Sepermadictyon suaveolens Roxb.

Borreria stricta (Linn. f.) Schum.

Asteraceae:

Centratherum phyllotaenum (D. C.) Benth ex Clarke

C. tenue (Wight) Clarke

Vernonia cinerea (Linn.) Less

V. divergens (Roxb) Edg.

Elephantopus scaber Linn.

Blumea mollis (Don) Merrill

B. membrenacea DC.

B. belangeriana DC.

B. malcolmii

Artemesia parviflora Buch. Ham. ex Roxb.

A. nilagirica (Clarke) Pamp

Gynura cusimbua Moore

Notonia grandiflora DC.

Senecio dalzellii Clarke

S. grahami Hook. f.

Tricholepis amplexicaulis Clarke

Lobeliaceae:

Lobelia nicotinaefolia Heyne

L. heyneana Roem and Sch.

L. alsinoides Lamk.

Campanulaceae:

Vahlenbergia marginata (Thunb.)

Plumbaginaceae:

Plumbago zevlanica Linn.

Myrisinaceae:

Embelia Tsjeriam-Cottam A. DC.

Sapotaceae:

Madhuca indica Gmel.

Ebenaceae:

Diospyros montana Roxb.

D. sylvatica Roxb.

D. candolleana Wight

Symplocaceae:

Symplocos laurina Wall ex Rehd. and Willis

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Oleaceae:

Linociera malabarica Wall. ex Don. Olea dioica Roxb.

Apocynaceae:

Carissa congesta Wight
Rauwolfia densiflora (Wall.) Benth. ex Hook f.
Rauwolfia serpentina (Linn.) Benth ex Kurz.
Alstonia scholaris (Linn. R. Br.
Holarrhena antidysenterica (Roth. A. DC.)
Wrightia tinctoria R. Br.
Chonemorpha fragrans (Moon) Alston
Anodendron paniculatum DC.

Asclepiadaceae:

Hemidesmus indicus Schultes Cryptolepis buchanani Roem and Sch. Holostemma annulare (Roxb.) K. Schum. Cynanchum calliata Ham. Gymnema sylvestre (Retz.) Schultes G. khandalense Santapau Tylophora fasciculata Ham. T. dalzellii Hook. f. T. indica (Burm.) Merr. Dregea volubilis (Linn. f.) Benth. ex Hook f. Hoya wightii Hook. t. Ceropegia attenuata Hook. C. lawii Hook. f. C. oculata Hook. var. oculata C. hirsuta Wt. and Arn. C. evansii McCann var. media Huber

Loganiaceae:

Strychnos colubrina Linn.

Gentianaceae:

Exacum bicolor Roxb.

E. pumilum Griseb.

E. petiolare Griseb.

E. lawii Clarke

Canscora khandalensis Santapau

Swertia minor (Griseb.) Kno bl.

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Boraginaceae:

Coldenia procumbens Linn. Trichodesma sedgwickianum Benerji Cyanoglossum wallichii G. Don.

Convolvulaceae:

Ipomoea nil (Linn.) Roth.
I. diversifolia R. Br.
Argyriea malabarica Choisy
A. elliptica Choisy

Solanaceae:

Solanum surattensis Burm. S. indicum Linn.

S. mccannii Santapau

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Scrophulariaceae:

Lindernia crustacea (Linn.) F. Mueller

L. antipoda (Linn.) Alst.

L. ciliata (Colsm.) Pennell

Buchnera hispida Buch, Ham.

Striga gesneroides (Willd.) Vatke

S. gesneroides var. minor Santapau

S. asiatica (Linn.) Kuntze

S. lutea var. albiflora O. Kuntze

S. densiflora Benth.

S. angustifolia (Don.) Sald.

S. sulphurea D and G

Rhamphicarpa longiflora (Arn.) Benth.

Sopubia delphinifolia G. Don. var. parviflora Benth.

Orobanchaceae:

Aeginetia indica Linn.

Aeginetia indica Linn. var. alba Santapau

A. pedunculata Wall.

Christisonia lawii Wight.

C. calcarata Wight

Lentibulariaceae:

Utricularia uliginosa Vahl

U. arcuata Wight

U. reticulata Smith

U. reticulata Smith var. parviflora Santapau

U. striatula Sm.

Gesneriaceae:

Rhynchoglossum notonianum (Wall.) Burtt

Bignoniaceae:

Oroxylum indicum (Linn.) Vent.

Dolichandrone falcata Seem. var. lawii (Seem.) Haines

Heterophragma quadriloculare (Roxb.) K. Schum.

Stereospernium personatum (Hassk.) Chatterjee

Radermachera xylocarpa (Roxb.) K. Schum.

Acanthaceae:

Blepharis asperrima Nees

Hygrophila serphyllum (Nees) Anders.

Hemigraphis latebrosa Nees var. heyneana Brem.

Carvia callosa (Nees) Brem.

Calcanthus grandiflorus (Dalz.) Radlk.

Haplanthus tentaculatus Nees var. tentaculatus

Neruracanthus trinervius Wight

Dicliptera ghatica Santapau

Justicia betonica Linn.

Rostellularis procumbens (Linn.) Nees

Rhinacanthus nasuta (Linn.) Kurz.

Verbenaceae:

Callicarpa tomentosa (Linn.) Murray

Tectona grandis Linn.

Gmelina arborea Roxb.

Vitex leucoxylon Linn.

Clerodendron viscosum Vent.

C. serratum (Linn.) Moon

Symphorema involucratum Roxb. Holmskioldia sanguinea Retz.

Labiatae:

Plectranthus mollis (Ait.) Spreng. Pogostemon purpurascens Dalz. P. benghalense (Burm.) O. Kuntze Dysophylla stellata Benth. Anisomeles heyneana Benth. Leucas lavandulaefolis Nees

Amaranthaceae:

Aerua sanguinolenta (Linn.) Blume Alternanthera sessilis (Linn.) DC.

Polygonaceae:

Polygonum plebejum R. Br.

Podostemeceae:

Terniola zeylanica Tul. var. konkanica (Willis) Santapau

Piperaceae:

Piper nigrum Linn.

Myristicaceae:

Knema attenuata (Wall.) Warb.

Lauraceae:

Cinnamomum zeylanicum Blume Actinodaphne angustifolia Nees Litsea deccanensis Gamble

Thymeliaceae:

Lasiosiphon eriocephalus Decne

Etaeagnaceae:

Elaeagnus conferta Roxb.

Loranthaceae:

Dendrophthoe falcata (Linn. f.) Etting
D. falcata Etting. var. coccinea (Talb.) Santapau:
D. trigonua (Wt. and Arn.) Danser ex Santapau:
Helicanthes elastica (Desr.) Dans.
Helicanthera obtusata (Schutt.) Dans.
Macrosolen capitellatus (Wt'. and Arn.) Dans.
Loranthus phillipensis Cham. and Schlecht.
Taxillus cuneatus (Roth.) Dans.
Tolypanthus lagenifer (Wight) van Tiegh.
Viscum angulatum Heyne ex DC.
V. nepalense Spreng.
V. monoicum DC.

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Santalaceae:

Osyris wightiana Wall. ex Wight

Balanophoraceae:

Balanophora indica Wall.

Euphorbiaceae:

Euphorbia pycnostegia Boiss.

E. khandalensis Blatt. and Hallberg

Bridelia squamosa Gehrm.

B. hamiltoniana Wall. ex Hook. f.

Glochidion hohenackeri Bedd.

Putranjiva roxburghii Wall.

Dimorphocalyx lawianus (Muell. Arg.) Hook. f.

Trewia polycarpa Benth.

Mallotus philippinensis (Lamk.) Muell. Arg.

M. stenanthus Muell. Arg.

M. aureo-punctatus (Dalz.) Muell. Arg.

Hura crepitans Linn.

Ulmaceae:

Holoptelea integrifolia (Roxb.) Planch.

Celtis cinnamomea Lindl.

Trema orientalis (Linn.) Blume

Urticaceae:

Fleurya interrupta (Linn.) Gaud.

Boehmeria acabrella (Roxb.) Gaud.

Pouzolzia zeylanica (Linn.) Benn.

Ficus tinctoria Forst. f. Subsp. parasitica var. parasitica Corner

F. drupacea Thunb. var. pubescens (Roth.)

F. nervosa Heyne

F. arnottiana Mio.

F. virens Ait.

F. asperrima Roxb.

F. hispida Linn. f.

F. racemosa Linn.

Antiaria toxicaria (Pers.) Leschera.

Salicaceae:

Salix tetrasperma Roxb.

Monocolyledons:

Hydrocharitaceae:

Blyxa octundra (Roxb.) Planc.

Burmanniaceae:

Burmania pusilla (Wall. ex Miers)

Orchidaceae:

Oberonia recurva Lindl.

Malaxis versicolor (Lindl.) Santapau and Kapadia

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Dendrobium microbulbon Rich.

D. sp. (D. mabelae Gammie)

D. ovatum (Willd.) Kranz.

D. barbatulum Lindl.

Porpax reticulata Lincl.

Eria reticosa Wight

E. microchilos Lindl.

E. dazlellii Lindl.

Thunia venosa Rolfe

Eulophia ochreata Lindl.

E. epidendraea (Retz.) Fischer

Rhynchostylis retusa (L.) Bl.

Gastrochilus dalzellianus (Santapau) Santapau and Kapadia

Aerides maculosum Lindl.

A. crispum Lindl.

Cottonia peduncularis (Lindl.) Reich. f.

Nervilia infundibulifolia Blatt. and Mc. C.

N. carinata (Roxb.) Schltr.

Peristylus stocksii (HK. f.) Kraenz.

Platanthera susannae (Linn.) Lindl.

Habenaria digitata Lindl.

H. gibsoni Hook f. H. gibsoni var. foliosa (A. Rich.) Santapau and Kapadia.

H. rariflora A. Rich.

H. ovalifolia Wight.

H. marginata Coleb.

Zingiberaceae:

Kuempferia scaposa (Nimmo) Benth. Hitchenia carlina (Graham) Baker Curcuma pseudomontana Graham C. purpurea Blatt. Zingiber cernuum Dalz.

Zingiber macrostachyum Dalz.

Costus speciosus (Koenig) Smith

Marantaceae:

Stachyphrynium spicatum (Roxb.) Schum. Phrynium capitatum Willd.

Musaccae:

Ensete superbum (Roxo.) Cheesman

Hypoxidaceae:

Hypoxis aurea Lour. Curculigo orchioides Gaertn,

Amaryllidaceae:

Crinum latifolium Linn.

C. asiaticum Linn.

Pancratium sanctae-mariae Blatt, and Hallberg

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Agaveaceae:

Agave ingens Berger

Dioscoreaceae:

Dioscorea pentaphylla Linn,

D. bulbifera Linn.

D. oppositifolia Linn.

D. belophylla Voigt

Liliaceae:

Asparagus racemosus Willd, var. javanica Baker Gloriosa superba Linn.
Iphigenia indica (Linn.) A. Gray
Scilla viridis Blatt, and Hallberg
Chlorophytum tuberosum (Roxb.) Baker
C. glaucum Dalz.
C. orchidastrum Lindl.

Smilaceae:

Smilax zeylanica Linn.

Commelinaceae:

Commelina suffruticosa Blume Murdannia spirata (Linn.) Brueckner M. malabarica (Linn.) Brueckner Cyanotis tuberosa (Roxb.) Schult. C. fasciculata (Heyne ex Roth) Schult. f.

Palmae:

Caryota urens Linn.

Phoenix sylvestris Linn. (Roxb.)

Borassus flabellifer Linn.

Typhaceae:

Typha angusta Bory and Chaub.

Araceae:

Cryptocorine spiralis (Retz.) Fisch. ex Wydler

Arisaema murrayi (Graham) Hook.

A. tortuosum (Wall.) Schott.

A. neglectum Schott.

A. leschenaultii Bl.

Sauromatum guttatum (Wall.) Schott.

Amorphophallus commutatus (Schott.) Engler

A. bulbifer (Roxb.) Blume

Ariopsis peltata Nimmo

Remusatia vivipara (Roxb.) Schott.

Potamogetonaceae:

Potamogeton indicus Roxb.

Eriocaulaceae:

Eriocaulon dianae Fyson

E. humile Moldenke

E. indicum Moldenke

E. lanceolatum Mig. var. pilosum Moldenke

E. santapaui Moldenke

E. gracile Mart.

Cyperaceae:

Cyperus albomarginatus Mart. and Schrad ex Nees.

C. articulatus Linn.

C. brevifolius (Rottb.) Hassk.

C. compressus Linn.

C. iria Linn.

Fimbristylis bisumbellata (Forsk.) Bub.

F. digitata Boeck

Gramineae:

Arthraxon hispidus (Thumb.) Makino

Arthraxon inermis Hook. f.

A. lancifolius (Trin.) Hochst

A. meeboldii Stapf.

Arundinella pumila (Hochst) Steud.

Bambusa arundinacea (Retz) Willd.

Bhidea burnsiana Bor

Bothriochloa compressa (Hook, f.) Henrard

Chionachne koenigii (Spreng.) Thw.

Coix lachryma-jobi Linn.

Cymbopogon martini (Roxb.) Wats.

Digitaria adscendens (H. B. K.) Henrard

Dimeria ornithopoda Trin.

Echinochloa colonum (Linn.) Link.

Eragrostis diarhena (Schult.) Steud.

E. pilosa (Linn.) Beauv.

E. unioloides (Retz.) Nees ex Steud

Heteropogon contortus (Linn.) Beauv.

H. triticeus (R. Br.) Stapf ex Graib

Hygrorhiza aristata (Retz.) Nees

Indopoa paupercula (Stapf) Bor

Isachne globosa (Thunb.) O. Kuntze
Ischaemum indicum (Houtt.) Merr.
I. diplopogon Hook. f.
I. semisagittatum Roxb.
Jansnella griffithiana (C. Muell.) Bor.
Melanocenchris jacquenontii Jaub. and Spach.
Oplismenus compositus (Linn.) Beauv.
Panicum psilopodium Trin.
Paspalum compactum Roth.
Sehima nervosum (Rottl.) Stapf
Setaria glauca (Linn.) Neauv.
Spodiopogon rhizophorus (Steud.) Pilger
Themeda quadrivalvis (Linn.) O. Kuntze
Tripogon ramosissimus (Hack.) Bor
Vetiveria zizanoides (Linn.) NASH

Besides the flowering plants a large number of ferns, mosses and liverworts grow at Khandala and Lonavala.

4.8: Flora of Sakharpathar, Ambavne:

This lies to the west of Pune at the edge of Deccan plateau in the Mawal and Mulshi talukas of Pune district adjoining Raigad district. Sakharpathar is a flat plain 900 m high and 5 km distant from Lonavala. It is difficult to approach in rainy season, but in other seasons it can be reached by a kuchcha road from Lonavala or by a similar road from Mulshi. Ambavne is still further, 23 km from Lonavala. The high level plateau has deep ravines and groves towards Raiagad district.

Being in the heavy rainfall zone the heavy rains are more than 100" and last from June to October. The soils are derived from basalt. They have been ripened in the heavy rainfall area, and as such, are not dark. They contain plenty of humus with gravel and disintegrated trap. They are however not deep nor have much ground cover. B. V. Reddi (1969) has described the plants of this area in *Bull. Bot. Surv. India*, in Vol. 11: 138—149: 249—259; and Vol. 12: 213—225. The list of important plants is given below. The cultivated and very common plants are omitted, and only characteristic species are given in the list here.

The vegetation at high altitude contains temperate plants like Cardamine tichocarpa. The ravines have evergreen and semi-green trees like Garcinia indica, G. talboti, Erinocarpus nimmonni, and also dry species like Kydia calicina, Capparis moonii, Sterculia guttata, Frimania coloraca, Dysoxylum binectariferum, Gymnosporia rothiana, Tregea edgeworthii, Allophyllus serratus, Schleichera oleosa, and a number of monsoon ephemeral, herbaceous plants occur, especially the legumes such as Smithia species. Seven species of it occur here. Among evergreen trees at the edge of the Sahyadris, Memecylon umbellatum, Pimpinella species are common. The vegetation consists of a mixture of evergreen and semi-evergreen species.

Flora of Sakharpathar and Ambavne Region of Pune District (from B. V. Reddi, 1969, 1970)

Ranunculaceae:

Clematis hedysarifolia DC.

Dilleniaceae:

Dillenia pentagyna Roxb.

Annonaceae:

Meiogyne pannosa (Dalz) Sincl. Miliusa tomentosa (Roxb.) Sincl. Sageraea laurifolia (Grah.) Blatt.

Menispermaceae:

Cissampelos pareira Linn. Cyclea burmanni (DC.) HK. f. and Th. Diploclisia glaucesens (Bl.) Diels Stephania japonica (Thunb.) Miers.

Brassicaceae:

Cardamine trichocarpa Hochst. ex Rich Rorippa indica (Linn.) Hiern

Capparidaceae:

Capparis moonii Wight. C. spinosa Linn.

Cleome chelidonii Linn. f.

Flacourtiaceae:

Flacourtia indica (Burm. f.) Merr. F. montana Grah.

Pittosporaceae:

Pittosporum floribundum Wt. and Arn.

Carvophyllaceae:

Polycarpon prostratum (Forsk.) Asch. and Sch.

Guttiferae:

Garcinia indica (Du pet. Thou.) Choiss. G. talbati Raiz. ex Sant. Mammea suriga (Bach-Ham. ex Roxb.) Kost.

Ancistrocladaceae:

Ancistrocladus heyneanus Wall.

Malvaceae:

Abelmoschus manihot (Linn) Medic Abutilon polyondrum Sch. Kydia calycina Roxb.

Bombacaceae:

Bombax ceiba Linn.
B. insigne Wall.

Sterculiaceae:

Eriolaena quinquelocularis Wight, Firmiana colorata (Roxb.) R. Br. Helicteres isora Linn. Sterculia guttata Roxb. S. urens Roxb.

Tiliaceae:

Erinocarpus nimmonii Grah. Grewia acutilifolia Vent. ex Juss. G. disperma Rottl. ex. Spr. G. tiliaefolia Vahl. var. argentea Burr.

Elaeocarpaceae:

Elaeocarpus oblongus Gaertn.

Linaceae:

Reinwardtia trigyna (Roxb.) Planch.

Malphigiaceae:

Aspidopterys cordata (Heyne) A. Juss. Hiptage benghalensis (Linn) Kurz.

Balsaminaceae:

Impatiens acaulis Arn.

I. balsamina Linn.

I. kleinii Wt. and Arn.

I. oppositifolia Linn.

I. pulcherrima Dalz.

Rutaceae:

Atalantia racemosa Wt. and Arn. Evodia lunu-ankenda (Gaertn.) Merr. Fagara budrunga Roxb. Glycosmis mauritiana (Lamk.) Tanaka Murraya koenigii (Linn) Spr. Paramignya monophylla Wight Toddalia asiatica (Linn) Bamk.

Burseraceae:

Canarium strictum Roxb. Garuga pinnata Roxb.

Meliaceae:

Amoora lawii (Wight) Bedd. Dysoxylum binectariferum (Roxb) Hook, f, ex. Bedd. Melia composita Willd. Toona ciliata Roem.

Olacaceae:

lacaceae : *Olax wightiana* Wall. ex. Wt. & Arn**.** Strombosia ceylanica Gardn.

Opiliaceae:

Cansjera rheedii Gmel.

Icacinaceae:

Nothopodytes foetida (Wt.) Sleumer.

Hippocrateaceae:

Gymnosporia rothiana (Wt. & Arn.) Laws. Reissantia grahami (Wt.) Ding. Hou. R. indica (Willd.) Hall.

Rhamnaceae:

Rhamnus trigueter (Wall.) Brand. Ventilago madraspatana Gaertn. Zizyphus glaberrima Sant. Z. rugosa Lamk.

Vitaceae:

Cissus discolor Bl. C. elongata Roxb. C. repanda Vahl. Tetrastigma camarense (Dalz.) Gamble.

Leeaceae:

Leea edgeworthii Sant. Leea indica (Burm. f.) Merr. L. robusta Roxb. L. setuligera Cl.

Sapindaceae:

Allophylluss serratus (Roxb.) Radlk. Lepisanthes tetraphylla (Vahl.) Radlk. Schleichera abeosa (Lour.) Oken

Anacardiaceae:

Anacardium occidentale Linn. Holigarna grahami (Wt.) Hook, f. Lannea coromandelica (Houtt.) Merr.

Connaraceae:

Rourea santaloides Wt. & Arn.

Fabaceae:

Aeschynomene indica Linn. Alysicarpus belgaumensis Wight A. vaginalis (Linn.) DC. Atylosia lineata Wt. & Arn. A. scarabaeoides (Linn.) Benth. A. sericea Benth, ex Baker Butea monosperma (Lamk.) Taub. Cassia filipes Benth. C. nana Burm. f. C. retusa Linn. C. vestita Baker Cylista scariosa Roxb. Dalbergia lanceolaria Linn. D. sympathetica Nimmo ex Roxb. D. triangulare (Relz.) Merr. Erythrina stricta Roxb. Geissaspis cristata Wt. & Arn. Moghania gracilis Mukh. M. strobilifera (Linn.) St. Hil. ex Jacks. Mucuna monosperma DC. M. prurita Hook. Phaseolus dalzellii Cooke Smithia bigemina Dalz. S. blanda Var. racemosa Baker S. conferta Sm. S. purpurea Hook. S. pycnantha Benth. ex Baker S. sensitiva Ait. S. selulosa Dalz. Teramnus labialis (Linn. f.) Spr. Vigna capensis Walp. *Zornia gibbosa* Span.

Caesalpiniaceae:

Bauhinia foveolata Dalz. B. racemosa Lamk. Cassia mimosoides Linn. C. fistula Linn. Mezoneuron cucullatum (Roxb.) Wt. & Arn. Wagatea spicata Dalz.

Mimosaceae ?

Acacia chundra (Roxb.) Willd.

A. nilotica (Linn.) Del. SSp. indica (Benth.)

A. sinuata (Lour.) Merr.

A. torta (Roxb.) Craib

Albizzia chinensis (Osb.) Mer.

Crassulaceae:

Kalanchoe pinnata (Lamk.) Pers.

Droseraceae:

Drosera indica Linn.

Rhizophoraceae:

Carallia brachiata

Combretaceae:

Anogeissus latifolia (Roxb.) Bedd.

Calycopteris floribunda (Roxb.) Lamk.

Combretum latifolium Bl.

C. ovalifolium Roxb.

Terminalia bellerica (Garrtm.) Roxb.

T. chebula Retz.

T. crenulata Roth.

Myrtaceae:

Syzygium canarensis Talbat

S. cumini (Linn.) Skeels.

S. jambos (Linn.) Alston

S. phillyraeoides (Trim.) Somt.

Lycythidaceae:

Careya arborea Roxb.

Melastomataceae:

Memecylon talbatianum Brandis

M. umbellatum Burm. f.

Osbeckia truncata Don.

Sonerila scapigera Hook.

Lythraceac:

Ammannia baccifera Linn.

A. multiflora Roxb.

A. senegalenis Lamk.

Lagerstruemia lanceolata Wall, ex Wt, Arn.

L. parviflora Roxb.

L. speciosa (Linn.) Pors.

Rotala densiflora (Roxb.) Kochne

R. floribunda (Wt.) Kochne

R. ocultiflora Kochne.

R. serpyllifolia (Roth.) Bremek

Woodfordia fruticosa (Linn.) Kurg

Onagraceae:

Ludwigia octovalvis (Jacq.) Raven SSP. sessiliflora (Mich) Raven. L. perennis Linn.

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Samydaceae:

Casearia graveolens Dalz.

Cucurbitaceae:

Dicoelospermum ritchici Cl. Momordica dioica Roxb. ex. Willd.

Begoniaceae:

Begonia concanensis DC.
B. crenata Dryand.

Molluginaceae:

Glinus lotoides Linn.

Apiaceae:

Centella asiatica (Linn.) Urban Heracleum concanense Dalz. Peucedanium grande Cl. Pimpinella adscendens Dalz. P. heyneana Wall. ex Kurz P. monoica Dalz.

Trachyspermum stictocarpum Wulff Var. hebecarpum (Cl.) Wulff. T. strictocarpum Wolffl var. stictocarpum Wulff.

In addition to the above, the following plants noted by B. Venkata Reddi (1970) at Ambavne Sakharpathar in *Bull. Bot. Sur. India*, vol. 12, pp 213—225 are worthy of note:

Droseraceae:

Drosera indica

Podostemaceae:

Dicracia stylosa Wight Griffithella hookeriana Warming Podostemon subulatum Gardn. Terniola zeylanica Tul. var. Konkanica (Willis) & Sant.

Piperaceae:

Peperomia wightiana epiphytic on Memecylon umbellatum

Loranthaceae:

Tolypanthus laginifer Van Tiegh.

Balanophoraceae:

Aroblasts ambayanensis Reddi

Araceae:

Ariopsis hastata Ninrmo

Burmanniaceae.

Burmunnia pusilla Thw.

4.9: Flora of Bhimashankar:

Bhimashankar is another important area of flora at an altitude of 3448' above M.S.L.,1000' more in height than Matheran. It lies 19°.04' N, 73°.32'E in Khed taluka and is known to be an important place of pilgrimage. It is one of the twelve Jyotirlingas, about 90 km from Pune. It is 48 km from Khed. It has a flat top, narrow and steep gorges and deep ravines. It lies, near the village Bhovargiri. Peth and Godavari ghat are closeby, Shinga and Kondaleshwar hills lie in the vicinity. The river Bhima rises from here and is joined by other small rivers like Bhama, Meena, Ghod, Kukadi, all rising in the vicinity.

The climate due to high altitude and presence of dense forests on one side is cold and dry. On the other sides the trap hills and plains are very dry. It lies on a crest of Sahyadri ranges. The rainfall is about 502 cm, but it becomes much less in the rain shadow region on the other side. Much of it falls in July-August and decreases after September-October. Humidity is 90 to 100% in rainy season. In other seasons it is 70% in the morning, but at noon 20—25%; naturally the plants dry up from January-February and hills look dark and barren.

Ratio of humid to drought period is 5:7. Rainfall is less than other hill stations at the edge of Sahyadris 523 cm per year. At Alandi in the rain shadow it is only 25.5 cm.

Hills are all trap hills. They disintegrate into coarse soil or gravel as the basalt here is mostly amygdaloidal. Soils are light, not very fertile being alkaline.

Drainage is from NW to SE, but the winds blow just in the opposite direction. Storms and hails are rare.

The vegetation here is largely determined by altitude, rainfall and poor soils. It consists of the following types:—

- (1) Semi-evergreen around Bhimashankar,
- (2) Deciduous about Maral, Ambegaon and Khed,
- (3) Thorn scrub about Shivaneri.
- (4) Low scrub at Gargatwadi and in region towards Shirur and Hardi. Open grasslands occur due to poor rainfall (about 75 mm) at Ambathan in Haveli taluka and at Shirur. The hill tops and flats have only low grass.
- (1) Semi-evergreen forests.—These occur at 900 m and above in the valleys and ravines, but they also dry up in some places in summer. Here the evergreen species, especially trees are dominant and they have to struggle for space and light. A good example of it is seen in Rai wood near Bhimashankar. At Bhovargiri vegetation is dominated by Memecylon umbellatum and Atlantia racemosa. In the Rai wood proper occur Olea dioeca, Litsca stocksi Symplocos beddomii, Helerophragma roxburghii, Actinodaphne angustifolia Allophyllus rheedii, Bridelia retusa, B. squamosa, Murraya paniculata and Mangifera indica. In addition to them Syzygium cumini is common. Leea indica, Ancistrocladus latifolia. One frequently finds Hoya carnosa on the outskirts of forests. In Rai wood shrubby vegetation consists of Carissa congesta, The-lspacpale ixiocephala, Carvia callosa, Acacia torta etc.

Climbers are Ventilago bombaiensis, Porana malaharica, Gymnema sylvestris, Cylista sp.

Herbaceous species and grasses occupy open spaces. Xerophytes, tuberous plants like Chlorophytum glaucum, ground orchids like species of Habenaria seem to dominate soil cover. At other places like Vanda proportion of semi-evergreen species becomes less. They imperceptibly merge into strands of deciduous species like Terminalia chebula, T. bellerica, Clematis gauriana, Hemidesmus indicus. Piper longum, Zizyphus rugosa. Several Striga sps., also are met with. Orchids Dendrobium barbatum, Oberonia recurva, Aerides maculosum, several mosses, occur on

the trees in these forests. In the stream in Rai wood Terniola zeylanica var. Konkanica Sant. is found. In Bhima river bed on rocks Griffithella macrocephala is seen floating in waters.

(2) Tropical Deciduous forests.—These are found on hill flats and plateaux at lower levels. Unlike semi-evergreen forests they are continuous near Biti, Kondaleshwar etc. They consist of Tectona grandis Terminalia crenulata, T. chebula, T. bellerica, Ficus racemosa, Anogeissus latifolia, Semicarpus anacaridum, Wrightia tinctoria, Certia malabarica etc.

Secondary species are Bridelia squamosa, Lagerstroemia lancelata, Albizzia amara, Acacia arabica and Euphorbia neriiolia. Common shrubs are Woodfordia fruticosa, Clematis triloba etc. Common grasses Cymbopogon martini, Lophoponon tritentatus, Aristida stocksii are plentiful.

- (3) Scrub or thorn savanna.—On Eastern side of Bhimashankar there is scrub jungle consisting of Carissa congesta, Lantana camara var aculeata Cassia aurimalata Plumbago zeylamica, Zizyphus glaberama, woody climber of Dregea volubilis and small grasses. Acacia leucophloea and Balanites roxburghii occur here and there.
- (4) Open grasslands.—These occur on gravel and open slopes of small hills and on unfertile plains during monsoons. Common grasses are Themeda quadrangulare, Cymbopogon martini, Heteropogon contortus, together with some legumes. But the edible fodder grasses are poor. They yield not enough fodder for the cattle here. It dries up soon due to surface soil getting dry. Weeds also are plenty and they also dry up.

On the other hand, in the valley and on plains where soil, is good papaya, Citrus and Punica granatum plantations develop well.

Monsoon ephemeral flora is not spectacular. Flora of Bhimashankar is not published. There are many medicinal plants in the hills of Khed taluka. They have been studied by K. P. Janardhanan (1963) and are enumerated by him in Bull. Surv. India. Vol. 5 (3-4): 363-374 and in Abstract Ind. Sc. Con. 1968. Some earlier collectors like Kanitkar, Bhide, H. P. Paranjpe had noted some plants of this area, but there has been no comprehensive account of them. It is highly needed as Maharashtra Government is opening Naneghat Ghat route to Bombay which will shorten the distance by about 64 km to Bombay from Ahmadnagar, Aurangabad etc. As a matter of fact, this was the old Moghul trade route. Another reason is that the Government has been trying to harness the rivers Ghod, Kukadi and Meena to irrigate the areas of Shirur in Pune District, Shrigonda, Parner and Karjat in Ahmadnagar, and Karmala in Sholapur. Bhimashankar also could be a hill resort on account of its cool dry climate.

4.10: Vegetation of Junnar Area:

Junnar lying on 19°.12' North latitude and 73°-53' East long. is an old taluka town known as Jeern nagar, 80 km. from Pune. It is on the leeward side of Sahyadri but a little in the interior. The area to its west receives 125 cm of rain but decreases towards east to 35 cm only. The vegetation naturally is not at all uniform. The area is uneven. There are many water-logged depressions. In the area near the crest of Sahyadri there

are semi-evergreen forests, generally in the ravines and valleys. On the Desh side there are deciduous forests which become sparser and sparser towards south and merge with scrub. In many ponds and water-logged areas aquatic plant communities and marshy plants grow.

Junnar town is surrounded by hills 183-330 m high above the ground; closeby there is Manmoda Ghat about 5 km north, and Shivaneri Fort to the west. The rivers Kukadi and Pushpavati drain the area. To the north-west of Kukadi river there is a vast cuplike depression, A dam is being constructed on Kukadi. The drainage is from NW to SE.

The rocks are derived from 6-8 trap flows which are mostly amygdaloidal and full of quartzs. Soils of various colour are formed from them in Kukadi basin. They are gravelly and unfertile; they are reddish due to laterite. Some soils are black, mixed with plenty of salts and forest debris. They are fertile. Rainfall at Junnar had been variable. Temperature 43.4° C is maximum and 25.21° C minimum, generally 29.30°.C. The climate is warm, but mild, dry after monsoons and pleasantly cold in winter. Humidity varies from 41% to 75%. Mean maximum temperature in May is 42.7°C and mean minimum is 17.6°C in December. In January it could be still as low as 9.7°C. Sometimes bitter cold winds blow in winter and also hail storms. Dust storms occur in early days of monsoons. The climate in the Ghat areas however is always mild and uniform. This is highly favourable for plant growth in forests and for the agricultural crops. Malvand and Borvand areas are very fertile. Otherwise people grow only Setaria italica and Eleusine coracana on unfertile gravelley soils of hill tops and slopes.

The rivers Kukadi, Meena, Pushpavati and many streams provide ample water to Junnar area. Lenyadri hill is closeby on the road going to Ozar. There is the famous Ganapati temple at Ozar which is one of the eight self-born shrines of Vinayak. Shivaneri fort famous as the birth place of Shivaji stands on the hill on outskirts of Junnar. Closeby from it passes the Malshej ghat which is really at the junction of Pune, Ahmadnagar and Nasik districts. It is about 8 km from Desh to Konkan plains below.

Vegetation.—The region has been studied by a few botanists like Gibson, Cooke, Woodrow, Bhide, H. P. Paranjpe, Bhiva, Puri and Mahajan, Vasavda, Jain, Ansari etc. Of these Gibson had established a botanical garden and an arboratum at the river bend near the village Hiwre, on river Kukadi in Junnar taluka. It is now submerged under the Kukadi dam.

There are some Dev-Raies here e.g. Durgabaichi Rai, Dhakobachi Rai. In and around them for some distance and in the valley of hills there is semi-evergreen vegetation consisting of Sterculia guttata Terminalia crenulata, Lagerstroemia lanceolata, Dillenia polygyna, Kydia, calycina, Mangifera indica, Syzygium cumini etc. Around this is a circle of Carvia callosa and small thorny scrubs. In the Raies there are woody climbers of Bauhinia vahlii, and then all of a sudden there is dry deciduous forest vegetation of Tectona grandis, Terminalia chebula, T. bellerica, Diospyros heterophylla, several Acacias and Balanites roxburghii. This in its turn changes into scrub and then into pastures or open grasslands.

At the edge of hills on the Sahyadri ranges there are plenty of trees of *Memecylon umbellatum* which when flower at the end of winter they form a gorgeous sight. On the river banks and streams *Bauhinia racemosa* and *Ficus* grow to fairly good size. In the grasslands many fodder as well as fibre and thatch grasses grow and so also the weeds.

Since the place was not frequently visited, many new records of species not known to grow have been made out by the members of the Botanical Survey of India, Western Circle. Some 9-10 new species of grass, Arthoxylon, Manisuris, Ischemum, a species of Chlorophytum, several new species of Ceropegia and a new genus Seshagiria are established by K. Hemadri, Ansari, Jain and others.

There are some rare plants, medicinal, economic and endemic. The world famous endemic Asclepiad, Frerrea indica was first discovered here from the edges of rocks and walls of Junnar fort nearly hundred years ago. There was no trace of it when McCann found it below Kate's point at Mahabaleshwar and Santapau found it at Vazirgad in Purandar fort. The plant is on way to extinction and is now seen in botanical gardens only.

The vegetation of Junnar fort is remarkable. It presents strong contrast all of a sudden by dry deciduous species or scrub around the semi-evergreen vegetation in Dev-Raies and valleys. This is no doubt due to high arid hills of Sahyadris at the west and north and vast dry plains of Desh on the other sides. Dr. Gibson's Park at Hiwre looks like an oasis in the midst of a dry semi-desert hills and low woodland savannah.

4.11: Gibson's Forest Park and Botanical Garden at Hiwre:

Hiwre is a small village in Junnar taluka on the bank of river Kukadi on its bend. The river rises in a higher nearby region of Sahyadri and brings down a lot of soil both by erosion and by its floods. Seeing the abundance of water, cool climate, variety of soil, Dr. Alexander Gibson chose this area in 1840 for a park and experimental garden for acclimatisation and improvement of economic species, and introduction of new species both from India and abroad which could be grown here. The park at Hiwre was the outcome of the great insight in forestry and plant life that Dr. Gibson had and his rich experience both as a botanist and as a forester.

Dr. Gibson's Forest Park at Hiwre had been a unique achievement and was one of the few such gardens in India at that time and even afterwards. A similar park was established on a large area more than 150 acres by J. F. Duthie, (the author of the Flora of the Upper Gangetic Plains) at Saharanpur which is now the garden of L. R. Brothers, Seedsmen and Nurserymen at Saharanpur.

came to India (Bombay) Alexander Gibson in 1825 to serve as a Medical Officer in the service of the East India England¹. In view of his Company of knowledge of trees, Dr. Gibson was appointed the first Conservator of Forests in the newly created Forest Department in Bombay, on At that time the forests were looked after by the 19th December 1846. Revenue Department, the auctions of timber and other materials from

Details of his life sketch are given in last chapter of this volume.

forests were made by the Military Department, and the whole thing was under the supervision of the Political Department. This three-fold control was always creating a lot of difficulties in his work. Many stands of rich forests of precious timber trees Teak, (Tectona grandis), Myrobalans, Adina cordifolia were being continuously cut down and destroyed. He also found that in the midst of thick forests both in North Kanara and elsewhere, there was a practice of 'Kumli' cultivation, whereby cultivators used to get higher yield of food crops by burning trees in the midst of forests before sowing crop seed. He devised laws regarding the removal of dead wood from the forests by the local people, chopping of side branches free of cost, inducing the local people to look after forests in the vicinity. He made spectacular contribution towards forest management.

After finishing his term of service he started the Forest Park at Hiwre. Here he built an Arboretum, made collection of many economic trees. medicinal plants and also other plants and built an herbarium. Several tree species were particularly brought from other parts of India like Assam, Mysore, Malabar, and he tried to grow them together, blending them with local ones. He had also brought plants from other countries e. g. Adansonia digitata, Bauhinia purpurea, Anacardium occidentale, Castiloa elastica, different equisetifolia, Casuarina Terminalias. Dalbergias, Putrajiva roxburghii, Lannaea glauca, Haematozylon campechianum, Milingtonia hortensis, Diospyros cordifolia, Pterospermum heyneanum, Gmelina arborea and several such useful woody species. nursery for growing and acclimatising their seedlings, study of the microclimate suitable to them was established. Growth habits and performance of exotic plants in the semi-arid climate of Hiwre and in the whole of Maharashtra were studied. A garden of ornamental and medicinal plants was also established. In course of years, the trees that he had grown were mingled with the semi-arid species of local plants such as Ceiba malabarica, Tamarindus indica, Acacias, etc. The experiments were successful because both the exotic and indigenous species grew to their full height, and it looked as if they had reached climatic climax in the new ecosystem. सत्यमव जयत

In 1860 Dr. Gibson retired from the position of the Conservator of Forests, Bombay, and went abroad. He was followed by his successor Dr. Stocks. He came back to Hiwre and died later at Bombay on 18th January 1867. But before that he had developed the Hiwre Garden to a great extent. His remains were buried in Hiwre Garden close to his residence, and his wife raised a huge monument in his memory. She even bequeathed the whole garden and park to the Forest Department which was supposed to look after them. His residence close to the memorial became the Forest Department Rest House for Forest Officers. Till 1942, however, the garden did not seem to have been well maintained or looked after as was originally planned by Gibson. In 1942, however, the Forest Department took over the management more seriously and declared it as a Preservation Plot, cutting down the tamarind and other wild local trees. They also wanted to develop various sections in the park namely (1) timber species, (2) fire wood species, (3) medicinal plants, (4) fruit trees, (5) minor forest produce plants, (6) ornamental plants, and (7) plants of botanical interest and those required for scientific research etc. Dr. Gibson's monument still stood after repairs and renovation; but the whole garden and the area was submerged under the high level dam on the Kukadi river for irrigation, and hydro-electric purposes. The main dam on Kukadi has already been constructed and much of the garden is submerged.

LIST OF PLANTS AT HIWRE PARK OF DR. GIBSON, TILL MARCH 1971

Annonaceae:

Miliusa tomentosa (Roxb.) J. Sm.

Annona squamosa Linn.

Polyalthia longifolia Benth. & Hook f.

Menispermaceae:

Stephania hernandifolia Walp.

Capparidaceae:

Capparis sepiaria Linn.

Malvaceae (Bombacaceae):

Bombax ceiba Linn, f.

Adansonia digitata Linn.

Cordia dichotoma Forst, f.

Sterculiaceae:

Guazuma ulmifolia Ham.

Pterospermum heyneanum Wall.

Tiliaceae:

Erinocarpus nimmoanus Grah. Grewia tiliaefolia Vahl.

Elaeocarpaceae:

Elaeocarpus sphaericus K. Sehum.

Rutaceae:

Feronia limonia Sur.

Simarubaceae:

Ailanthus excelsa Roxb. Balanites roxburghii Planch.

Meliaceae:

Azadirachta indica A. Juss. Chloroxylon swietenia DC. Swietenia mahogoni Linn.

Rhamnaceae:

Dodonaea viscosa Linn. Sapindus emarginatus Vahl. =S, trifoliatus Linn.

Schleichera oleosa O. Ken.

Anacardiaceae:

Lannea coromandelica (Houtt.) Merx. Mangifera indica Linn.

Papilionaceae (Leguminosae):

Dalbergia latifolia Roxb.

D. melanoxylon Guill.

D. paniculata Roxb.

D. sissoo Roxb.

Pongamia pinnata Benth.

Caesalpiniaceae (Caesalpinae-Leguminosae):

Bauhinia diphylla Buch.-Ham.

B. purpurea Linn.

B. racemosa Lamk.

B. vahlii W. & A.
Caesalpinia dicapetala Alston
C. coriaria Willd.
C. pulcherrima Sw.
Cassia fistula Linn.
Haematoxylon campachianum Linn.
Saraca indica Linn.
Tamarindus indica Linn.

Mimosaceae (Mimosae-Leguminosae):

Acacia catechu Willd.

A. leucophloea Willd.

A. nilotica Del. ssp. indica

A. summa Buch.-Ham.

Adenanthera pavonina Linn.

Albizzia amara Boiv.

A. lebbek Benth.

Leucaena glauca Poenth.

Combretaceae:

Terminalia arjuna W. & A.

T. bellirica Roxb.

T. crenulata Roth.

Cornaceae:

Alangium salviifolium (Linn. f.) Wang.

Rubiaceae:

Ixora arborea Roxb, Ed sm.

-I. parviflora Vahl.

Sapotaceae:

Madhuca indica Gmel.

Ebenaceae:

Diospyros cordifolia Roxb.

D. melanoxylon Roxb.

D. montana Roxb.

Oleaceae:

Schrebera swietenioides Roxb.

Apocynaceae:

Carissa congesta Wight.

Bignoniaceae:

Heterophragma quadriloculare K. Sch.

Millingtonia hortensis Linn.

Stereospermum xylocarpum B. & H. F.

Loganiaceae:

Strychnos nux-vomica Linn.

Verbenaceae:

Gmelina arborea Roxb.

Tectona grandis Linn.

Santalaceae:

Santalum album Linn.

Euphorbiaceae:

Aleurites moluccana Willd. Cicca acida (Linn.) Merr.

Euphorbia antiquorum Linn. E. tirucalli Linn. Putranjiva roxburghii Wall.

Urticaceae:

Castiloa elastica Cerv. Holoptelea integrifolia Planch. Ficus bengalensis Linn. F. elastica Roxb. F. glomerata Roxb. F, religiosa Linn.

Agavaceae:

Agave sisalana Per.

Palmaceae:

Caryota urens Linn. Phoenixsylvestris Roxb.

4.12: List of Plants in Pune and nearby districts by Dr. B. A. Razi (1952):

(Arrangement of families is as per Engler and Diels 1936, syllabus der Pfianzen families).

Pandanaceae:

Pandanus Sp. Parwati

Potamogetonaceae:

Zea mays Linn.

Potamogeton indicus Roxb. .. Parwati

. .

Euchlaena americana Schrad

Gramineae:

Chionachne semiteres (Benth.) Law College hill Pune ... Round Junnar =Polytoca barbata Benth. Ischaemum ciliare Retz. .. Ganeshkhind Bhorkas near Pune I. diplopogon Hook, f. Chatushringi, Kalas near Lonavala I. pilosum Hack. I. semisagittatum Roxb. Panchgani Schima nervosum Stap f. ... Lohagad plain, Bhairawadi near Schima spathiflorum Blatter and Mc Cann. Purandar. S. sulcatum A. Camus Kalas near Lonavala = Ischaemum sulcatum Hack. Cultivated at Pune Pollinidium binatum (Retz.) C. E.

Sinhagad, Panchgani

'ollinidium binatum (Retz.) C. E. Hubbard.

Thelepogon elegans Roth.

Lophopogon tridentatus Hack. .. Chatushringi, Kalas near Lonavala Apluda aristata Linn. .. Kalas, Ganeshkhind

Katraj ghat

=A. varia Hack.

A. aristata Hack. .. Purandar.

Rottboellia exaltata Linn. f. . . Agriculture College, Pune

R. robusta Hook. f. Poona
Saccharum officinarum Linn
S. spontaneum Linn
Linn
Linn
Purandar
Cultivated
Pune on river bank

S. spontaneum Linn. ... Pune on river bank
Spodiopogon albidus Benth. ... Ganeshkhind, Sinhagad, Lohagad

Eulalia argentea Brongn. .. Lohoga

Bothriochloa pertusus (Willd.) .. Agriculture College Campus, Pune

=Andropogon pertusus Willd	Kalas near Lonavala
Arthraxon, inermis Hook, f	Purandar
A. jubatus Hack	Top of Lohagad
A. lanceolatus Hochst	Pune, Law College hill
A. lancifolius Hochst.	
=A. microphyllus Hochst	Pune, Law College hill
A. serrulatus Hochst	Pashan tank
Capillipodium filiculinis (Hook. f.)	Pune. Purandar
	I unc. I urandar
Stapf. Amphilophis compressus Blatter	Pune
and MacCann.	Tunc
	At fact of Lohngod Mound
A. odorata A. Camus	At foot of Lohagad, Mawal
A. pertusa Stapf	Pashan, Agriculture College, Pune
A. woodrowii A. Camus	
A. squarrosus Hook, f.	n n 1
Sorghum halpense (Linn.) Pers	Pune, Purandar
= Andropogon halpensis Brot	Ganeshkhind
S. purpureo-gericeum Aschers	Kalas near Lonavala
Chrysopogon montanus Trin	Kirkee, Pashan
=Andropogon monticola Schult.	Katraj, Pune
Dichanthium annulatum Stapf	Kirkee to Pune
=Andropogon annulatus Forssk.	Purandar, Chatushringi,
SER	Ganeshkhind Panchgani.
D. caricosum A. Camus	Junnar, Shevgaon (Dist. A'nagar)
=Andropogon caricosus Linn	Lohagad, Purandar
=Andropogon contertus Linn	Pune, Kalas
Heteropogon insignis Thy	Pune, Kalas near Lonavala,
Treeropogon magnia Tityi.	Chatushringi, Mawal.
=Andropogon triticous R. Br.	Character in Els Wall
	77 4 3 4 311 . 75
	Katrai hills bear Pube
H. ritchiei Blatter and McCann	Katraj, hills near Pune
=Anthistiria cymbaria Roxb.	881727).
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze	Pashan, Purandar
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze =Anthistiria ciliata Linn. f.	Pashan, Purandar Bhairawadi, Pune
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze =Anthistiria ciliata Linn. f.	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar.
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack T. triandra Forssk Iseilema anthophoroides Hack. I. prostratum Anderss =I. wightii Andress Eremopogon foveolatus Stapf. =I. wightii Anders. =Andropogon pumilus Roxb	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack T. triandra Forssk Iseilema anthophoroides Hack. I. prostratum Anderss =I. wightii Andress Eremopogon foveolatus Stapf. =I. wightii Anders. =Andropogon pumilus Roxb. Cymbopogon citratus Stapf	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar Kalas near Lonavala
= Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. = Anthistiria ciliata Linn. f. T. tremula Hack T. triandra Forssk Iseilema anthophoroides Hack. I. prostratum Anderss = I. wightii Andress Eremopogon foveolatus Stapf. = I. wightii Anders. = Andropogon foveolatus Del. Andropogon pumilus Roxb. Cymbopogon citratus Stapf. C. martinii Stapf.	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar Kalas near Lonavala Pashan, Purandar, Ganeshkhind
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=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar Kalas near Lonavala Pashan, Purandar, Ganeshkhind
=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack T. triandra Forssk Iseilema anthophoroides Hack. I. prostratum Anderss =I. wightii Andress Eremopogon foveolatus Stapf. =I. wightii Anders. =Andropogon foveolatus Del. Andropogon pumilus Roxb. Cymbopogon citratus Stapf. C. martinii Stapf. Paspalum pseudanthistiria heteroclita Hook. f.	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar Kalas near Lonavala Pashan, Purandar, Ganeshkhind
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=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack T. triandra Forssk Iseilema anthophoroides Hack. I. prostratum Anderss =I. wightii Andress Eremopogon foveolatus Stapf. =I. wightii Anders. =Andropogon foveolatus Del. Andropogon pumilus Roxb. Cymbopogon citratus Stapf. C. martinii Stapf. Paspalum pseudanthistiria heteroclitation Hook. f. P. hispida Hook. f. Digitaria marginata Link.	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar Kalas near Lonavala Pashan, Purandar, Ganeshkhind Pune Purandar Law College hill, Pune
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=Anthistiria cymbaria Roxb. Themeda quadrivalvis O. Ktze. =Anthistiria ciliata Linn. f. T. tremula Hack T. triandra Forssk Iseilema anthophoroides Hack I. prostratum Anderss =I. wightii Andress Eremopogon foveolatus Stapf. =I. wightii Anders. =Andropogon foveolatus Del. Andropogon pumilus Roxb. Cymbopogon citratus Stapf. C. martinii Stapf. Paspalum pseudanthistiria heteroclita Hook f. P. hispida Hook f. Digitaria marginata Link. —Paspalum sanguinale Lamk. var. ciliare. var. fimbriata Stapf. D. pedicellaris Prain —Paspalum pedicellare Trin.	Pashan, Purandar Bhairawadi, Pune Pune, Purandar near foot of hill Ganeshkhind, Bhairawadi near Purandar. Katraj Kalas near Lonavala Pune Kalas near Lonavala Law College hill Pune, Pashan, Bhairawadi near Purandar Kalas near Lonavala Pashan, Purandar, Ganeshkhind Pune Purandar Law College hill, Pune Law College hill, Pune Law College hill, Pune Chatushringi

Brachiaria isachne (Griseb.) Stapf.	Bhamburda Kalas near Lonavala Purandar
B. ramosa Stapf. —Panicum ramosum Linn. B. mutica Stapf	Law College hill, Pune Cultivated at Kirkee Pune, Kirkee Bung Garden, Pune Pune Katraj, Ganeshkhind, Chatushringi.
Urochloa panicoides Beauv Panicum javanious Bl.	Kalas near Lonavala
U. reptans Stapf U. setigera Stapf Echinochloa colona Link	Kirkee, Pune Ganeshkhind Purandar at the foot Nira canal, Kalas near Lonavala.
E. crus-galli Beauv. —Panicum crusgalli Linn. Panicum montanum Roxb. P. obscurans Woodrow	Law College hill Half way up Lohagad Manjri farm, near Pune Pune
P. trypheron Schult Setaria intermedia R. and S	Chatushringi, Law College hill Purandar, Chatushringi, Law College hill
S. italica Beauv	Ganeshkhind Shivapur near Pune Kalas near Lonavala
Pennisetum hoenackeri Hochst exssteu.].	
—P. bediceliatum Trin. P. purpureum Schumm and Thom. —P. typhoideum Rich.	
Cenchrus ciliaris Linn —Pennisetum cenchroides Rich.	Kalas near Lonavala
C. setigerus Vahl. C. biflorus Roxb. Isachne australis R. Br.	Ganeshkhind Law College hill, Pune Pune
Arundinella holcoides Trin —A. agrostoides Trin.	Law College hill, Punc
—A. brazilliensis Raddi. A. avenacea Munro.	
Thysanolaena precumbens Mez	Ganeshkhind
Aristida adscencionis Linn	Pashan.
-A. depressa Rets	Law College hill, Pune
A. funiculato Trin. and Rupr	Pashan, Kirkee, Katraj, Kalas near Lonavala.
Aristida hystrix L	Ganeshkhind
A. redacta Stapf	Junnar, Lohagad, Pashan, Law College hill, Pune. Ganeshkhind
	Chatushringi.
Tragus biflorus Schult T. racemosus Stapf.	

Nazia racemosa Kuntze	Pune, Chatushringi
Sporobolus diander Beauv	Katraj, Chatushringi
S. coromandelianus Link,	Poona Agriculture College farm
S. indicus R. Br	Chatushringi.
Eragrostis bifaria Wt	Chatushringi, Law College hill
E. cilianensis (All.) Link.	Kalas at Lonavala
E. major Hochst	Purandar, Kirkee, Pune Agri.
·	College farm.
E. gangetica Steud	Pune Mawal.
E. interrupta Beauv	Bawdhan near Pune, Ganesh-
•	khind, Bhairawadi near Puran-
	dar.
E. minor Host	Purandar, Bhimthadi,
	Chatushringi.
E. nutans (Retz.) Nees	Pashan, Purandar
E. pilosa Beauv	Waghoti near Mawal, Bhirawadi
— , <i>p</i> , , , , , , , , , , , , , , , , , , ,	near Purandar, Chatushringi.
E. viscosa Trin.	Chatushringi.
=E. tenella R. and S	Kalas near Lonavala
E. plumosa Stapf.	Pune
Oropetium thomacum Trin	Sinhagad forest, Kalas near
Oropetium momucum same	Lonavala, Law College hill, Pune.
Melanocenchris royleana Nees	Katraj, Sinhagad
Cynodon dactylon Pers	Service Control of the Control of th
C, virgata Sw	Manjri near Pune, Katraj,
C, virguita Sw.	Bhamburda.
C gayana Kunth	Cultivated in Pune
C. Adjusta IIIIII	Cultivated in Pune
Dictionic conticuition —	Pune
E. flagellifera Nees	Chatushringi, Law College hill,
E. indica Gaertn	Pune.
D. J. Landing Regulations People	Tuije.
Dactyloctenium aegyptium Beauv.	Panadi
=Eleusine aegyptiaca Desf	Bopodi Deolali, Dhond
Dinebra retroflexa Psch	IV-1 I amounto Ami Collogo
= D. arabica Jacq	farm.
Tripogon capillatus Jaub and Pach	. About Pune
Tripogon jacquemontii Stapf.	Pune Agri. College, Kirkee,
, , , ,	Purandar, Kalas near Lonavala.
T. lisboae Stapf	
T. roxburghianus Bhide	Chatushringi, Kalas near Lonavala,
•	Law College hill, Pune.
Hygrorhiza aristata Nees .	. Poona Agri. College garden
Elytrophorus spicatus A. Camus	Law College hill, Pune
= E. articulatus Beauv.	
Oryza sativa L	. Cultivated in Mawal
Triticum vulgare L.	
T. vulgaris Schard	. Pune, Satara, Kolhapur
Oxytenanthera ritchiei Blatter and	Pune district
Mc Cann.	
Dendrocalamus strictus Nees .	. Ganeshkhind.
Deliti ocatalisto di letto 1 1000	•
Cyperaceae:	
	. Pune
K. triceps Rottb.	. Chatushringi, Kalas near Lonavala
	. Purandar, Mawal
	Riverside Pune, Manjri near Pune,
1. Stotional Referit.	Ganeshkhind.

P. nitens Nees	Panchgani
P. pumilus Dom	Bhusi near Mawal
P. sanguinolentus Nees	In bed of water courses, Talegaon
Juncellus laevigatus Clarke	Nira canal
Juncenus neviguius Clarke	Bhairwadi near Purandar, Katraj
J. michelianus (Linn.) Blatter and	tank.
Mc Cann.	
Cyperus aristatus Rottb	Purandar fort, Talegaon, Parwati,
71	Pune, Kirkee, Khed.
C. bulbosus Vahl	Kirkee
C. compressus Linn	Agri. College garden, Pune
C. Compressus Linn.	Pune, Kirkee
C. corymbosus Rottb	Ganeshkhind, Pune, Bopodi,
C. digitatus Roxb.	
	Chinchwad.
C. eleusinoides Kunth	Along water courses, Talegaon,
OI DICHAMITE TO THE STATE OF TH	Ganeshkhind, Bopodi.
C iria Linn	Purandar, Bhairwadi, Shivapur,
C. iria Linn	Shivaneri fort.
C. teneriffae Poir	Pune, Chatushringi, Junnar
C. rotundus Linn	Purandar, Agriculture College
	farm, Kirkee, Parwati tank,
	Kalas near Lonavala.
Mariscus konkanensis Sedgwick	
Mariscus konkanensis seaguiek	Riverside Pune, Manjri near Pune,
Eleocharis capitata R. Br.	Nine Carel Chinabayad
G-ESE	Nira Canal, Chinchwad.
E. fistulosa Link	Panchgani Table-land
Fimbristylis aestivalis Vahl, var.	Mawal, Ganeshkhind,
diphylla Kukenth.	0000000
	Chatushringi.
F. complanata Ljnk	Demakasasi
F. miliacea Vahl.	W Walter Committee Committ
F. monostachya Hassk	
F. tetragona R. Br.	Mawal
F. woodrowii Clarke	
Bulbostylis capillaris Kunth var.	Purandar.
trifida Clarke.	No. of the last of
	Pune
Scirpus quinquefarius Ham.	. Pune . Panchgani, Bhairwadi near
S. supinus Linn.	, rancingain, infantwaci near
	Purandar.
Fuirena wallichiana Kunth.	. Pashan, Pune
Rhychospora wightiana Steud	. Pune
	. ·Talegaon
Eriophorum comosum Wall. var.	
Eriophorum Comosum Wan, var.	011111111111111111111111111111111111111
major Fischer.	
Palmae:	of the trouble Westername
Phoenix sylvestris (Linn.) Roxb.	Sinhagad, Shirur, Yeravda,
•	Katraj.
Caryota urens L	. Katraj
Curyota wiens 21	•
A =0.0000 t	•
Araceae:	. Yeravda
Pistia stratiotes Linn.	
Cryptocoryne retrospiralise Roxb	
=C. spiralis Fischer ex Wydler.	Pune
Typhonium amboinenso (Rumph)	
Blatter and Mc Cann.	
Colocasia esculenta (Linn.) Schot	t. Sinhagad
=Arum esculentum L	Torna
Calangia autimomum Cabatt	
=Colocasia antiquorum Schott.	. Lohagad, Purandar, Torna
Remusatia vivipara Schott.	. Longgau, Furanuar, Torna

Amorphophallus commutatus Engl. Sauromatum guttatum (Wall.)

Schott.

Ganeshkhind Junnar, Panchgani

Commelinaceae:

Commelina forskalei Vahl.

Kalas near Lonavala

Murdannia semiteres (Dalz.) Sinhagad . .

=Ancilema scmiteres Dalz.

C. fasciculata Schult. Kalas near Lonavala, Chatushringi, Law College hill.

C. glabrescens Clarke Sinhagad, Pune

C. tuberosa Schult. Kalas near Lonavala, Chatushringi

Liliaceae:

Kalas near Lonavala, Law College Asparagus racemosus L. ... hill, Vetal hill.

Gloriosa superba Linn. Torna

Kalas near Lonavala Asphodelus tenuifolius Cav. Chlorophytum laxum R. Br. Law College hill

Chlorophytum orchidastrum Lindl. Range hill, Ganeshkhind, Pune C. tuberosum Enker Kalas near Lonavala, Law College

hill, Pune, Katraj. Urginea indica Kunth. Law College hill

Scilla indica Baker. Law College nill, Kalas near Lonavala, Katraj.

Iphigenia indica Kunth. Vetal hill, Law College hill, Chatushringi.

Sirur, Chatushringi Dipcadi montanum Dalz.

Amaryllidaceae:

Agave vivipara Wt.

Curculigo orchioides Gaertn. Panchgani, Torna

Dioscoreaceae:

Torna Dioscorea alata L. Torna D. bulbifera D. hispida Dennst. Sinhagad . .

=D. daemona Roxb.

D. oppositifolia L. Sinhagad, Torna D. wallichii Hook f. Sinhagad

Musaceae:

Sinhagad Ensete superbum (Roxb.)

Checseman.

=Musa superba Roxb.

Zingiberaceae:

Curcuma decipiens Dalz. Torna Zingiber macrostachyum Dalz. Sinhagad

Foot of Visapur Costus speciosus Sm.

Cannaceae:

Ganeshkhind Canna indica Linn.

Orchidaceae:

Dendrobium barbatum Lindl. Sinhagad Zeuxine strateumatica Schlecht. Pashan.

Eulophia pratensis Lindl. Habenaria affinis Wt. H. commelinifolia Wall. H. crassifolia A. Rich. H. digitata Lindl. H. foliosa A. Rich. H. grandiflora Lindl. H. lengicalcarata A. Rich. H. marginata Colebr. H. rariflora A. Rich.		Pune, canal side, Pashan Purandar Purandar Purandar, Panchgani Purandar Hills about Khadakvasla Mawal, Shivapur, Purandar Purandar, Katraj ghat Junnar, Purandar Khandala, Lonavala, Karkala near Pune, Purandar.
Moraceae:		
Trema orientalis Bl	٠.	Parwati, Sinhagad
Ficus arnottiana Miq		Sinhagad
F. bengalensis L	••	Malavli to Bhaja, on way to Lohagad.
F. glomerata Roxb		Malavli to Bhaja, Panchgani
F. religiosa L		Yeravda, Vetal hill, Katraj ghat.
P		
	• •	Sinhagad
F. retusa L.	• •	Malavli to Bhaja, Sinhagad
Artocarpus integra (L.) Merr.		Torna
A. lakoocha Roxb		Torna
	20	610
Urticaceae:	27.E	MEGA.
Girardinia zeylanica Decne.		Sinhagad, Torna, Lohagad
Lecanthus peduncularia (Wall) Wedd.		Sinhagad
=L. wallichii Weed.	MHZ.	S9467
=L. wightii Wedd.	A 12	7.47
=Procris peduncularis Wall.	му	V. W. V
	KLA.	Malasti 4. Dhais
Boehmeria scabrella Goud.	• • •	Malavli to Bhaja
Proteaceae: Grevillea robusta Cunn.		Cintrate 1
Grevittea rootista Cunn.		Sinhagad
Santalaceae:	योष	न जयते
zamanacout.	-4.1	1 141
Osyris wightiana Wall		
=O. arborea Wall		Katraj hills
Santalum album Linn.		Bhamburda, Torna, Law College
		hill, Vetal hill.
Lorenthesees		
Loranthus longiflorus Desf.		Law College hill, Pune
=Dendrophthoe falcata Ettingh		
L. scmrrula L.		
Taxillus cuneatus (Roth.) Dense	г	Sinhagad
=Loranthus cuneatus Roth	•	
Viscum album Linn		Sinhagad Votesi
	• •	Sinhagad, Katraj
V. angulatum Heyne ex DC.	• •	Sinhagad, Katraj
V. articulatum Burm	• •	Law College hill, Pune
A mint = 1 = -1 :		• • • • • • • • • • • • • • • • • • • •
Aristolochiaceae:		
Aristolochia bracteata Retz.	• •	Deccan in fields of Jowar
Polygonaceae:		
Polygonum glabrum Willd.		Sinhagad
P. plebejum R. Br. var, indica		Rajgad, Sinhagad
Hook. f.		
P. serrulatum Cooke		Concern builden Dire-
serraiaiami Cooke		Sangam bridge, Pune

Chenopodiaceae:	A weed in Poona gardens,
Chenopodium ambrosioides Linn.	Yeravda.
Amaranthaceae:	
Celosia argentea Linn	Lohagad, Kalas near Lonavala.
Digera arvensis Forssk	. Kalas near Lonavala, Law College hill, Pune, Yeravda.
Amaranthus spinosus L	. Malavli to Bhaja, Law College hill, Pune, Torna, Yeravda.
A. viridis L	
Pupalia atropurpurea Moq	
Achyranthes aspera L	Pune, Malavli to Bhaja, Torna, Law College hill, Pune.
Aerua javanica Juss	. Deccan, not common
A. lanata Juss	. Chatushringi, Law College hill, Pune.
A. scandens (Roxb.) Wall	. Sinhagad
Alternanthera sessilis (Linn.) R. E	
	. Sangam bridge, Pune
5	Law College hill, Pune, Yeravda
Gomphrena celosioides Mart	. Yeravda
67,532	全局 第3
Nyctaginaceae:	7 O. H 170 D
	. Law College hill, Pune
=B. repens L	. Sirur, Kalas near Lonavala, Yeravda.
Phytolaccaceae:	9 V. U. V
Phytolacca barbata Stapf.	. Kalas near Lonavala
Portulacaceae:	302(7F)
Portulaca oleracea L	. Malavli to Bhaja, Torna, Kalas near Lonavala, Law College hill,
=Talinum cuneifolium Walld.	Sinhagad.
Aizoaceae:	
1.6 P. 1. PDI 1	. Sinhagad
" '' ''	. Malavli to Bhaja, Torna, Law hill, Pune.
Trianthe ma pentandra L.	. Babhulgaon
Caryophyllaceae:	
	. Kalas near Lonavala, Chatushringi
Dianthus cannonbullus I inn	. Cultivated in Mahabaleshwar
Ranunculaceae:	
Clematis gouriana Roxb.	Talegaon, Chinchwad
	Sinhagad
C. triolba Heyne	Sinhagad, Lohagad
Menispermaceae ·	
Menispermaceae: Tinosporu cordifolia (Willd) Miet	s Lohagad Sinhagad Down
	's Lohagad, Sinhagad, Pune Pune
C 1 1 . D' 1	Sinhagad
0 · 10 - D0	Law College hill, Pune, Katraj
Stephantea hernandifolia Walp.	Hills near Junnar, Malavli to
· · · · · · · · · · · · · · · · · · ·	Bhaja.

Cissampelos pariera Linn. Cyclea burmanni Miers C. fissicalyx Dunn =C. peltata Cooke	• •	Sinhagad Pune, Lohagad Torna, Katraj Lohagad
Magnoliaceae: Michelia champaca L	••	Cultivated in Pune
Anonaceae: Anona squamosa L. Artabotrys odoratissimus R.	Br.	Parwati, Vetal hill, Katraj Torna, Panchgani (Cultivated)
Lauraceae: Actinodaphne hookeri Meissn	ı	Foot of Visapur, Torna, Rajgad
Papaveraceae:		
Argemone mexicana L	••	Weed at Katraj, Sinhagad, Mala- vli to Bhaja, Torna, Lohagad, Kalas near Lonavala, Yeravda.
Capparidaceae:		
Gynandropsis pentaphylla DC	7	Pune, Panchgani
Cleome chelidonii Linn. f.	PTT0	Between Pune and Karla
C. simplicifolia Hook. f. and		Pune, Kalas near Lonavala, Chatushringi.
C. monophylla L.	33.5	Tan Olius in B
C. viscosa L		Deccan dry lands, Law College
Markey manager I I a la C and	1 771	hill, Pune.
Maerua arenaria Hook, f. and	1 I U.	Pune
Cadaba indica Lam	778 Y	Deccan dry lands
Capparis aphylla Roth	LXM	Deccan dry lands
C. dicidum Pax		Pune
C. divaricata Lam		Deccan dry lands, Law College hill, Pune.
C. grandis Linn	The state of	Bhuleshwar hill, Parwati, Katraj
C -ulmion I imm	मनामेव	Pune Pune
C housida Linn f		Ganeshkhind, Katraj
· · · · · · · · · · · · · · · · · · ·	• •	
C. subumbellata Hook, f.	• •	Torna, Lohagad
Brassica nigra Koch	••	Torna, Yeravda
Moringaceae: Moringa oleifera Lamk	••	Sinhagad, Pashan, Katraj
Crassulaceae:		
Bryophyllum pinnatum (Lami Kurz.	k .)	Sinhagad, Panchgani
=B. calycinum Salisb		Torna
Kalanchoe olivacea Dalz.	••	Sinhagad, Torna
75		
Rosaceae:		C 10 A. I. A. D.
Fragaria vesca L	••	Cultivated at Panchgani
Prunus communis L	• •	Panchgani
P. persica Stocks	• •	Panchgani cultivated
Pyrus malus L	• •	Do.
Rosa multiflora Thunb.	•	Do.
Rubus lasiocarpus Sm. 🕳		Do.
•		
Leguminosae: Mimosoideae		
Prosopis spicigera L.	_	Sirur
Tropokin shire Quin mi	_	***

Acacia arabica Willd	Kalas, Pune near Lonavala,	
	Chatushringi, Talegaon, Ka	
A. catechu Willd.	Pune, Katraj	•
A. concinna DC	Katraj	
A. ferruginea Lamk	Law College hill, Pune	
A. intsia (Linn.) Willd.	Sinhagad	
A. leucophloea Willd	Chatushringi, Law College	hill
iii teweopinoew (tilia:	Pune, Parwati, Vetal hill.	14111,
A. melanoxylon R. Br	17	
411 1 . L L . L . D L		
	Law College hill, Pune	
Cicer arietinum L	Sinhagad	
Caesalpinioideae:		
Caesalpinia pulcherrima Sw.	Cultivated in Pune	
Delonix regia Raf.	Cultivated in Pune	
Deionix regiu Kai.	Vancorda - 17-4-11 '11	
=Poinciana regia L	Yeravda, Vetal hill	
Parkinsonia aculeata L.	Sirur	
Cassia auriculata L	Deccan dry lands, Law Colleg	ge
	hill, Pune.	
C. fistula Linn	Sinhagad, Katraj, Panchgani	
C. kleinii W. and A	Kalas near Lonavala	
C. marginata Roxb	Vetal hill	
C. mimosoides L	Ganeshkhind	
C occidentalie Linn	Ganeshkhind	
C. pumila Lamk.	Sinhagad, Torna, Ganeshkhin	d
C nissas I am	NO. O. ST. CO. CO. CO. CO. CO. CO. CO. CO. CO. CO	u
C down Time		
C. tora Linn	Malavli to Bhaja, Torna,	
	Chatushringi, Law College	nill,
	Pune.	
70 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
Bauhinia tomentosa L	Ganeshkhind, Bhamburda	
	DESIGNATION OF THE PROPERTY OF	
Tamarindus indica L	Near Lohagad village	
	Disagnosina, -Na resulta 1250	
Tamarindus indica L. Hardwickia binata Roxb.	Near Lohagad village Law College hill, Pune	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae:	Near Lohagad village Law College hill, Pune	
Tamarindus indica L. Hardwickia binata Roxb.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala,	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi.	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex F	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schrank.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad	/ alaa
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex F	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, k	C alas
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, kalas near Lonavala.	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schrank.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, kalas near Lonavala Sinhagad, Kalas near Lona	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae: Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schrank. C. filipes Benth C. juncea Linn.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, kalas near Lonavala Sinhagad, Kalas near Lonayeravda.	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Inear Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Innear Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Kalas near Lonavala Sinhagad, Kalas near Lonavala Law College hill, Pune Sinhagad Law College hill, Pune	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, k near Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Kalas near Lonavala Sinhagad, Kalas near Lonaveravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Innear Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Gancshkhind Sinhagad	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne of	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Innear Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Gancshkhind Sinhagad	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne of Roth.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Is near Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Chatushringi.	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne of Roth.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Is near Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Chatushringi.	
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne Roth. Indigofera endecaphylla Jacq	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Is near Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Chatushringi Sinhagad.	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne of Roth.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Inear Lonavala Sinhagad, Kalas near Lonaveravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Ganeshkhind Sinhagad Chatushringi Sinhagad Ganeshkhind, Kalas near L	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schtank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne Roth. Indigofera endecaphylla Jacq I. glandulosa Willd.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Innear Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Ganeshkhind Sinhagad Chatushringi Sinhagad Ganeshkhind, Kalas near L vala, Sinhagad.	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae. Heylandia latebrosa DC. Crotalaria albida Heyne ex F. C. calycina Schrank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne Roth. Indigofera endecaphylla Jacq	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Is near Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Sinhagad Chatushringi Sinhagad Ganeshkhind, Kalas near L vala, Sinhagad Ganeshkhind, Kalas near L	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schtank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne of Roth. Indigofera endecaphylla Jacq I. glandulosa Willd. I. linifolia Retz.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Innear Lonavala Sinhagad, Kalas near Lona Yeravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Ganeshkhind, Kalas near L vala, Sinhagad Ganeshkhind, Kalas near L vala, Sinhagad Ganeshkhind, Kalas near L	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schtank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne e. Roth. Indigofera endecaphylla Jacq I. glandulosa Willd. I. linifolia Retz. I. pulchella Roxb	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Forar Lonavala Sinhagad, Kalas near Lonaveravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Chatushringi Sinhagad Chatushringi Sinhagad Ganeshkhind, Kalas near Levala, Sinhagad Ganeshkhind, Kalas near Levala, Sinhagad Ganeshkhind, Kalas near Levala, Law College hill, Pun	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae : Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schtank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne ex Extended Roth. Indigofera endecaphylla Jacq I. glandulosa Willd. I. linifolia Retz. I. pulchella Roxb. I. trifoliata Linn.	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Innear Lonavala Sinhagad, Kalas near Lonaveravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Ganeshkhind Sinhagad Chatushringi Sinhagad Ganeshkhind, Kalas near Levala, Law College hill, Pun	vala,
Tamarindus indica L. Hardwickia binata Roxb. Papillioneae . Heylandia latebrosa DC. Crotalaria albida Heyne ex E. C. calycina Schtank. C. filipes Benth C. juncea Linn. C. linifolia Linn. f. C. medicaginea Lamk. C. mysorensis Roth. C. nana Burm. C. orixensis Rottl. C. triquetra Dalz. Indigofera cordifolia Heyne e. Roth. Indigofera endecaphylla Jacq I. glandulosa Willd. I. linifolia Retz. I. pulchella Roxb	Near Lohagad village Law College hill, Pune Torna, Kalas near Lonavala, Chatushringi. Roth. Sinhagad Sinhagad Malavli to Bhaja, Torna, Forar Lonavala Sinhagad, Kalas near Lonaveravda Law College hill, Pune Sinhagad Law College hill, Pune Sinhagad Ganeshkhind Sinhagad Sinhagad Chatushringi Sinhagad Chatushringi Sinhagad Ganeshkhind, Kalas near Levala, Sinhagad Ganeshkhind, Kalas near Levala, Sinhagad Ganeshkhind, Kalas near Levala, Law College hill, Pun	vala,

Tephrosia purpurea Pers.	• •	Ganeshkhind, Belapur in Ahmed- nagar district, Kalas near Lonavala.
T. tenuis Wall	••	Kalas near Lonavala, Law College hill, Pune.
Sesbania aculeata Poir		Ganeshkhind, Kalas near Lonavala,
S. aegyptiaca Poir		Yeravda
Geissaspis cristata W. E. A.		Malavli to Bhaja
Zornia diphylla Pers	• •	Chatushringi, Kalas near Lonavala, Torna, Law College hill, Pune.
Taverniera nummularis Baker		Law College hill, Punc.
Smithia blanda Baker		Torna
S. hirsuta Dalz,	٠.	Do.
S. purpurea Hook	• •	Torna, Malavli to Bhaja, Sinha- gad.
S. setulosa Dalz		Torna, Sinhagad
Aeschynomene indica L.		Law College hill, Pune.
Alysicarpus belgaumensis Wt.		Torna
A. longifolius W. and A.		Ganeshkhind
A. monilifer DC	••	Kalas near Lonavala, Law College hill, Pune.
A. pubescens Law	400	Ganeshkhind, Law College hill,
	modified in	Pune.
A. rugosus DC	4134	Kalas near Lonavala, Ganeshkhind
A. tetragonolabus Edgew.		Sinhagad, Chatushringi, Law College hill, Pune.
A. vaginalis DC		Malavli to Bhaja, Torna, Pashan, Law College hill, Pune.
A. nummularifolius Baker	0.74	Panchgani.
Desmodium diffusum DC.	140	Law College hill, Pune.
D. rotundifolium Baker	di di di	Sinhagad
D. triflorum (L.) DC		Bhaja to base of Lohagad, Torna, Malavli to Bhaja, Sinhagad.
D. triquetrum DC.	The state of	Panchgani
Abrus precatorius Linn.	सवा	Katraj, Chatushringi, Law College hill, Pune.
Terammus labialis Spr.	••	Malavli to Bhaja, Law College hill, Pune.
Erythrina indica Lamk.		Do.
E. stricta Roxb		Sinhagad
Mucuna prurita Hook		Do.
=M. pruriens Cooke.		
Butea monosperma O. Ktze.		Do.
=B. forndosa Koening ex Ro	oxb.	
Canavalia gladiata DC.		
=C. ensiformis Baker		Do.
Phaseolus khandalensis Santa	pau	Do.
=P. grandis Dalz.		
P. trilobus Ait	• •	Kalas near Lonavala, Ganeshkhind, Chatushringi.
P. radiatus Linn		Sinhagad, Torna
=P. sublobatus Roxb		Law College hill, Pune
Dolichos biflorus Linn		Sinhagad
Atylosia scambaeoides (Linn. Benth.)	Sinhagad, Law College hill, Pune
A. sericea Benth		Torna
Rhynchosia bracteata Benth.		• Sinhagad

R. minima DC. .. Ganeshkhind, Kalas near Lonavala, Chatushringi, Dalbergia lanceolaria Linn. f. Sinhagad D. latifolia Roxb. ... Sinhagad, Law College hill, Pune Law College hill, Pune D. sissoo Roxb. Pongamia glabra Venth. . . Malavli to Bhaja, Parwati, Pashan Katraj. Oxalidaceae: Oxalis corniculata L. Sinhagad, Torna, Lohagad, Katraj, Law College hill, Pune. Naturalised at Panchgani Oxalis latifolia H. B. K. O. tetraphylla Cav. Naturalised at Panchgani Biophytum sensitivum (Linn) DC. Ganeshkhind, Chatushringi, Sinhagad. Monsonia senegalensis G. and P. Kalas near Lonavala Linaceae: Linum mysorense Heyne .. Foot of Torna fort, Sinhagad Reinwardtia trigyna Planch, ex Malavli Zygophyllaceae: Fagonia cretica L. Newasa in Ahmednagar Guaiacum officinale Linn. .. Ganeshkhind Tribulus terrestris Linn. Law College hill, Pune Rutaceae: Murraya koenigii Spr. .. Bhor Atalantia monophylla DC. . . Junnar, Panchagni Feronia limonia (Linn.) Swingle . . Pune, Sinhagad =F. elephantum Corr. Simarubaceae: Balanites roxburghii Planch ... Between Shevgaon and Pathardi (district Ahmednagar). Ailanthus excelsa Roxb. Law College hill, Pune, Shirur Burseraceae: Chatushringi, Bham Sinhagad, Vetal hill Boswellia serrata Roxb. . . Bhamburda, Garuga pinnata Roxb. Sinhagad, Law College hill, Pune Meliaceae: Turraea villosa Benn. Rajgad Cipadessa baccifera (Roth) Mig. Sinhagad =C. fruticosa Bl. Torna, Katraj, Parwati Azadirachta indica A. Juss. Sirur, Bhamburda, Kalas near Lonavala, Yavat, Katraj. Heynea trijuga Roxb. Katraj Malpighiaceae: Aspidopterys cordata (Heyne) Sinhagad Hiptage bengalensis (Linn.) Kurz. Panchgani, Pune (cultivated) Polygalaceae: Polygala chinensis L. Kalas near Lonavala, Ganeshkhind.

Chatushringi,

P. elongata Klein P. erioptera DC	Law College hill Pune, Panchgani, Kalas near
P. persicariaefolia DC	Lonavala, Chatushringi, Sirur. Sinhagad
Euphorbiaceae:	
Euphorbia antiquorum Linn.	. Malavli to Bhaja, Sinhagad
E. coccina Roth	77 1 Y 1
E. elegans Spreng.	TO I C. U. IND.
E. geniculata Ort	C. 11-11-1 T. C. H. 191
an germanara Ott.	Pune, Kalas near Lonavala.
E. hirta L	Common land and Common late and
=E. pilulifera L	Chatushringi, Kalas near Lonavala,
•	Torna, Sinhagad, Yeravda,
T	Katraj.
E. hypericifolia L	Ganeshkhind, Kalas near Lonavala,
T	Chatushringi.
E. reriifolia Linn	T
=E. ligularia Cooke	
E. rothiana Spr E. tirucalli (27 - 4 - 1 - 1 - 11 - 275 3 - 3 - 3 - 1 - 1 - 1 - 1 - 1 - 1 -
E. tirucalli L	Bhaja, Katraj, Torna.
Pedilanthus tithymaloides Poit	Malavli to Bhaja, Katraj, Torna
Bridelia retusa Spr	Hills of Deccan, Sinhagad,
Dimena reass opt.	Panchgani.
B. squamosa Gehrm.	- 1 C 4 1 T
Phyllanthus maderaspatensis L.	Kalas near Lonavala, Chatushringi,
The state of the s	Ganeshkhind, Law College hill, Pune.
P. niruri L	Law College nill, Pune, Lohagad
Emblica officinalis Gaertn.	Sinhagad, Torna
=Phyllanthus emblica Linn.	SEC. ALMERICA
Fluggea leucopyrus Willd.	Chatushringi, Talegaon, Law
The state of the s	College hill, Pune, Katraj.
F. microcarpa Bl.	Torna, Kalas near Lonavala
Securinega virosa (Roth) Pax and	Sinhagad
Hoffm.	
Phyllanthus virosa Roxb.	Ci-torad
Melanthosa turbianata Wt.	Sinhagad
Breynia patense Koen ex Roxb.	Ganeshkhind
Putranjiva roxburghii Wall Chrozophora prostrata Dalz	Tra 1
C. rottleri Kletsch.	37 1
Acalypha brachystachya Hornem.	Sinhagad
A. malabarica M. Arg.	Consolition I am College hill
11. // // // // // // // // // // // // //	Pune, Kalas near Lonavala.
A, wilkesiana M. Arg	C
Homonoia riparia Lour.	17-4-1 d:
Ricinus communis L	Near Torna village, Bhaja village,
	Sinhagad, Yeravda.
Jatropha curcas L	
	Lohagad, Torna, Pashan
J. glandulifera Roxb	
J. nana Dalz	
Tragia cannabina L	
T. involucrata Linn	Foot of Visapur
Anacardiaceae:	
4 11MV41 WIMUVHU	· ·
	Law College hill. Pune
Buchanania lanzan Spr A-127—44-A.	Law College hill, Pune

G. obtusa Wall.

A-127-44-B.

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Sinhagad, Malavli to Bhaja, Mangifera indica L. Torna, Sirur, Katraj. Sinhagad, Pune Semecarpus anacardium Linn. f. Bhamburda, Katraj ghat, Odina woodier Roxb. Chatushringi. Bhamburda, Law College hill, Rhus mysurensis Heyne ... Katraj. Celastraceae: Parwati, Sinhagad, Katraj Celastrus paniculata Willd. Sinhagad, Bhamburda, Gymnosporia montana (Roxb) Chatushringi, Katraj hill. Bentn. G. rothiana Laws ... Talegaon Chatushringi, Law College hill Elaeodendron glaucum Pers. Salvadoraceae: Sirur Salvadora oleoides Decne. Sapindaceae: Cardiospermum halicacabum Linn. Chatushringi, Ganeshkhind Malavli to Bhaja, Torna, Rajgad, Allophylus cobbe Bl. Lohagad. .. Ganeshkhind, Katraj Dodonea viscosa L. Balsaminaceae: Impatiens balsamina Linn. var. Torna agrestis Hook. I. balsamina Linn. var. resea Hook. Torna Malavli to Bhaja =I. balsamina Linn. var. brevicalcarata. ... Purandar 1. dalzelli Hook. f. and Th. 📶 Rhamnaceae: Vetal hill, Chatushringi, Kalas Zizyphus jujuba Lamk. near Lonavala, Torna, Sinhagad, Katraj. Chatushringi, Kalas near Lonavala, Zizyphus oenoplea Mill. Torna, Šinhagad, Katraj. Torna, Sinhagad, Panchgani Z. rugosa Willd. ... Belapur, Chatushringi, Z. xylopora Willd. Bhamburda. Vitaceae: Raigad Vitis elongata Wall. Ganeshkhind . . V. vinifera L. ... Sinhagad Cissus elongata Roxb. . . Malavli to Bhaja =Vitis elongata Wall. . . Deccan C. pallide Planch. $=Vitis_{i}$: llida W, and G. Chatushringi C. setos. Roxl. ... Law College hill =Vitis se tosa Wall. ٠. Sinhagad, Vetal hill C. woodrowii Santapau =Vitis woodrowii Stapf. Torna, Talegaon, Chatushringi . . Sinhagad Cayraytia carnosa G. agnep. . . Ganeshkhind =Vitis trifolia Linn. . . Malavli to Bhaja Leea macrophylla Roxb. Tiliaceae: Malavli to Bhaja, Chatushringi Grewia asiatica Linn.

Law College hill

	1 4010	A OL		
G. tiliaefolia Vahl. Triumfetta pilosa Roth. T. rotundifolia Lamk.	••	••	College hill.	aw.
Corchorus antichorus Rai	uesch	• •	Deccan, on poor soils	
C. fascicularis Lamk.			Law College hill	
C. trilocularis Burm.			Kalas near Lonavala, Ganeshkh	i n d
Malvaceae:				
Abutilon polyandrum W.	and A		Purandar, Panchgani	
Gossypium hirsutum L.		٠,	Kalas near Lonavala	
Malvastrum coromandeli	anuta		Pune	
Garck.				
Sida acuta Burm.			Yeravda	
S. grewioides Guill. and	Perr.		Kalas near Lonavala	
S. rhombifolia L			Torna	
S. retusa Mast			Pune, Panchgani	
S. rhomboides Mast.			Sinhagad	
S. spinosa Linn			Chatushringi	
S. veronicaefolia Lamk.			Sinhagad, Torna	
Urena lobata Linn.			Torna, Malavli to Bhaja	
Hibiscus cannabinus Lim			Sinhagad	
H. ficulneus L.	0	47.D	Ganeshkhind	
H. micranthus Linn, f.	(3.55	3,150	Kalas near Lonavala.	
H. rosa-sinensis L.	- William	355	120100 11001 120110 11111	
Thespesia populnea L.	- 68		Malavli to Bhaja	
Bombacaceae : Salmalia malabarica So	144	1	ΊΥ	
Endl.	باور	REA	Torna Malavli to Bhaja, Pune, Ka	ıtraj
Endl. — <i>Bombax malabaricum</i>	باور	REA	FW3	ıtraj
Endl. —Bombax malabaricum Sterculiaceae:	باور	REA	Malavli to Bhaja, Pune, Ka	ıtraj
Endl. —Bombax malabaricum Sterculiaceae:	DC.		Malavli to Bhaja, Pune, Ka	ıtraj
Endl. —Bombax malabaricum Sterculiaceae:	DC.		Malavli to Bhaja, Pune, Ka	ıtraj
Endl. —Bombax malabaricum Sterculiaceae:	DC.		Malavli to Bhaja, Pune, Ka	ıtraj
Endl. —Bombax malabaricum Sterculiaceae:	DC.		Malavli to Bhaja, Pune, Ka	ıtraj
Endl. —Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind	ıtraj
Endl. —Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae:	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani	ıtraj
Endl. —Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind	ıtraj
Endl. —Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani	ıtraj
Endl. —Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae:	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani Valavana (Pune district)	ıtraj
Endl. -Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae: Casearia graveolens Da	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani	ıtraj
Endl. -Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae: Casearia graveolens Da. C. tomentosa Roxb.	DC.	2H-	Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani Valavana (Pune district) Mawal	itraj
Endl. —Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae: Casearia graveolens Dace tomentosa Roxb. Flacourtia latifolia T.	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani Valavana (Pune district) Mawal Cooke.	
Endl. -Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kui Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae: Casearia graveolens Da. C. tomentosa Roxb. Flacourtia latifolia T. Flacourtia ramontchi L.	DC.	2H-	Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani Valavana (Pune district) Mawal Cooke. Bhamburda, Rajgad, Vetal	itraj
Endl. -Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae: Casearia graveolens Da. C. tomentosa Roxb. Flacourtia latifolia T. Flacourtia ramontchi L. Heri	DC.		Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani Valavana (Pune district) Mawal Cooke.	
Endl. Bombax malabaricum Sterculiaceae: Pterygota alata R. Br. Guazuma tomentosa Kut Theaceae: Camellia thea Link Elatinaceae: Bergia odoratissima Flacourtiaceae: Casearia graveolens Dacentosa Roxb. Flacourtia latifolia T. Flacourtia ramontchi L. Heri Cochlospermaceae:	DC.	4 di	Malavli to Bhaja, Pune, Ka Planted at Pune Ganeshkhind Cultivated near Panchgani Valavana (Pune district) Mawal Cooke. Bhamburda, Rajgad, Vetal Law College hill.	ıil'
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692 BOTANY AND FLORA Thymelaeaceae: Lasiosiphon eriocephalus Decne. . . At the foot of Lohaged, Malavli to Bhaja, Sinhagad. Elaeagnaceae: Malavli to Bhaja Elaeagnus kologa Schlecht =E. latifolia Lythraceae: Rotala tenuis (Wt.) Koehne Sinhagad =Ammannia tenuis Clarke. Vetalwadi Ma avli Ammania baccifera Linn. . . Sinhagad, to Bhaja, Parwati. Chatushringi Woodfordia fruticosa (L) Kurz ... Lohagad, Torna, Malavli to == W. floribunda Salisb Bhaia. Lawsonia inermis L. Malavli to Bhaja Combretaceae: Terminalia arjuna W. and A. Pune, Law College hili T. chebula Retz. Torna, Yeravda Sinhagad. T. crenulata Roth. eners. =T. tomentosa W. and A. Raigad T. paniculata Roth. Lohagad T. tomentosa W. and A. ... Bhamburda, Visapur, Torna ... T. bellerica Roxb. Bhor taluka Anogeissus latifolia Wall. Sinhagad, Chatushringi, Bhamburda. Calycopteris floribunda Lamk. Panchgani, Khandala Myrtaceae: Psidium guyava Linn. Sinhagad, Malayli to Bhaja, Parwati. Syzygium cumini (Linn.) Skeels ... =Eugenia jambolana Lam. Torna, Malavli to Bhaja Sinhagad Myrtus communis Linn. ... Melastomaceae: Memecylon umbellatum Burm. ... Bhimashankar Oenotheraceae: Oenothera rosea Ait. Sinhagad Umbelliferae: Carum stictocarpum Clarke Panchgani Pimpinella adscendens Dalz, Sinhagad . . P. monoica Dalz. Sinhagad, Malavli to Bhaia, . . Visapur. P. multiradiata Santapau Sinhagad Sinhagad, Panchgani P. tomentosa Dalz. Trachyspermum stictocarpum Sinhagad (Clarke) var. typica Wolff.

Primulaceae:

Anaeallis arvensis Linn. var. Pune on wet garden soil, Torna, caerrulea Gren, and Godr. Sinhagad.

Plumbaginaceae:

Plumbago zeylanica L. .. Sinhagad, Panchgani

Sapotaceae: Mimusops elengii L	Panchgani, cultivated in Pune
Ebenaceae: Diospyros melanoxylon Roxb	Deccan
Symplocaceae: Symplocos beddomei Clarke	Panchgani, Khandala ghat
Oleaceae:	
Jasminum malabaricum Wt. var. obovatum Clarke	Lohagad, Torna, Malavli to Bhaja, Sinhagad, Parwati.
Nyctanthes arbor-tristis L Schrebera swietenioides Roxb	Ganeshkhind Chatushringi
Gentianaceae:	
Exacum bicolor Clarke	Pune, Pashan
E. pumilum Gris	Pashan, Law College hill, Parwati, Yeravda.
Erythraea roxburghii Don Canscora decurrens Dalz	Kalas near Lonavala, Torna Kalas near Lonavala
Canscort. decurrens Daiz	Raias ileai Eonavaia
Canscora diffusa R. Br	Sinhagad, Panchgani, Torna, Malvali to Bhaja.
C. khana'alensis Santapau	Sinhagad
Swertia decussata Nimmo	Torna, Panchgani
Apocynaceae:	2947
Carissa congesta Wt	Sinhagad, Panchgani
=C. carandas L	Malavli to Bhaja, Lohagad, Vetal
Plumeria acuminata Ait	hill, Chatushringi. Sinhagad, Malavli
=P. acuifolia Poir.	Malavli to Bhaja, Lohagad, Vetal hill, Ganeshkhind.
Holarrhena antidysenterica Wall	Panchgani, Sinhagad, Lohagad, Ganeshkhind, Vetal hill.
Wrightia tomentosa R. and S	Ganeshkhind, Law College hill
Nerium i dicum Mill	Sinhagad, Torna
=N. odorum Art	Vetal hill
Vinca pusilla Murr	Kalas near Lonavala
Asclepiadaceae:	
Hemidesonus inclicus R. Br	Purandar, Pune, Sinhagad, Malavli to Bhaja, Torna, Chatu- shringi.
Cryptolep's buch anani R. and S.	Near Pune, Sinhagad, Malavli to Bhaja, Torna, Lohagad, Katraj.
Cryptostegia grandiflora R. Br	On way Pune to Wai, Malavli to Bhaja, Kalas near Lonavala.
Calotronii gigantea R. Br	Panchgani, Chatushringi, Law College hill.
C. hirsute W. and A	Yeravda
Asolepius curassavica Linn	Pune, Yeravda
Oxystelma esculentum R. Br Horostemma anvulare K. Schumm.	Pune, river bank near Sangam Kothrud near Pune, Bawdhan
Pergularia daemia Blatter and	Kalas near Lonavala, Pune
McCarra. Sarcostemma acidum Voigt	Pune, Chatushringi hill

=S. brevistigma W. and A	Law College hill		
S. intermedium Decene	Katraj ghat		
Gymnema sylvestris R. Br	Panchgani and also in Deccan dry lands.		
Tylophora dalzellii Hook	Law College hill, base of Lohagad		
Marsdenia volubilis T. Cook	Pune, Law College hill, Katraj		
M. angustifolia Hook. f	Common at Pune		
Oianthus deccanensis Talbot	Ghat west of Pune.		
O. urceolatus Benth	Pune,		
Heterostemma dalzellii Hook. f.	Pune		
Leptadenia reticulata W. and A.	Chatushringi, Belapur (Ahmed-		
•	nagar), Law College hill.		
Ceropegia attenulata Hook	Junnar		
C. hirsuta Wt	Law College hill		
C. hispida Blatter and McCann.	Near Gadavli, Panchagani		
C. lawii Hook	Torna, Sinhagad		
C. tuberosa Roxb	Law College hill		
Caralluma adscendens R. Br.			
C. attenuata	Bopodi near Pune		
C. fimbriata Wall	Chatushringi, Law College nill,		
	Katraj.		
	Purandar		
Dregea volubilis Benth	Chatushringi, Vetal hill		
Convolvulaceae:	Total Chata		
Rivea hypocrateri formis Choisy	Law College hill, Katraj Chatu-		
A Carlo Man Carlo	shringi.		
Argyreia cuneata Ker Gaw 1	Sinhagad, Katraj, Ganeshkhind,		
A (Deal) City	Law College hill, Pune.		
A. setosa (Roxb.) Cnoisy	Sinhagad		
Lettsomia setosa Roxb.			
Lettsom a elliptica Wt.	Malayli to Bhaja, Panchgani Ganeshkhind		
Ipomoea hederacea Jacq	Ganeshkining		
I. nil Rotha	Cimbogad		
	Sinhagad Kalas near Lonavala		
I. pes-tigridis L			
I. soluta Kerr	G: 1 4		
=I. companulata	C = = -1.1.1.1.1.4		
Quamoclit phoenicea Choisy . =Ipomoea concinia Clarke			
~ " · ·			
Q. pinnata	O 1 1.1 ! - 4		
Calonictyon muricatum G. Den			
=Ipomoea muricata Jacq.			
Porana malabarica Clarke	Grown in gardens		
Evolvulus alsenoides L	Law College hill, Chatushringi,		
	Torna.		
Merremia emarginata Hall. f	. Ganeshkhind		
= Ipomoea reniforis Choisy			
Boraginaceae	•		
Cordia dichotoma Forst f	. Sinhagad		
=C. obliqua Willd	•		
=C. myxa Auct	•		
Ehretia aspera Willd			
<u>-</u>	Katraj.		
Heliotropium ovalifolium Forssk	Kalas near Lonavala, Law College		
· · · ·	hill.		
H. supinum L	Pune, Law College hill		

H. tuberculosum Boiss	Chatushringi, Pune Law College hill.	
H. zeylanicum Lam	Shevgaon (Ahmednagar)	
Trichodesma amplexicaule Roth	Ganeshkhind, Torna, Sinhagad	
T. indicum R. Br	Law College hill, Ganeshkhind	
Cynoglossum denticulatum DC	Malavli to Bhaja	
Paracaryum lambertianum Clarke	Torna	
z w wear your ransocration of the control		
Verbenaceae:		
Lantana camara Linn, var. acaleata	Ganeshkhind, Chatushringi, Kalas	
Moldenke.	near Lonavla.	
Lippea nodiflora Michx	Vithalwadi, Kalas near Lonavala,	
	Torna, Yeravda.	
Callicarpa lanata L	Katraj, Rajgad, Panchgani	
Tectona grandis Linn. f	Bhamburda, Sinhagad, Katraj,	
V	Vetal hill.	
Clerodendron inerme Gaertn	Katraj	
C. phlomoides Linn. f	Deccan	
C. serratum (Linn.) Murr	Sinhagad, Torna	
Vitex negundo L	Rajgad, Sinhagad, Sirut, Lohagad	
	Torna, Katraj.	
Duranta plumeri Jacq	Ganeshkhind	
0.00		
Labiatae:	3633	
Ocimum americanum Linn	Pashan, Katraj	
== 0. cannum Sims	Chatushringi, Law College hill,	
	Pune.	
Orthosiphon pallidus Royle	Chatushringi, Law College hill,	
O 4 - 4 Death	Pune.	
O. tomentosus Benth	Kalas near Lonavala	
Plectranthus coesta Buch Han	Sinhagad	
P. mollis (Ait.) Spr.	Panchgani, Sinhagad	
=P. incanus Link,	Malavli to Bhaja Ganeshkhind	
Lavandula bipinnata O. Ktze	** 1 T O D	
=L. burmanm Benth	hill.	
7 manattatii Danth	Torna, Sinhagad	
L. perottetii Benth Pogost mon parviflorus Benth	Sinhagad, Malvali to Bhaja,	
Pogosi mon parvitorus Benen	Lohagad.	
Dysophylla stellata Benth	Sinhagad, Panchgani	
Colebrookia oppositifolia Sm	Sinhagad, Lohagad, Torna	
Anisomeles ovata R. Br	Sinhagad	
Leucas aspera Spr	Pune, Law College hill	
L. biflora R. Br	Mutha river, Vitthalwadi	
L. la sandulaefolia Rees	Sinhagad	
=L. livifolia Spr	_	
L. long folia Bentn	Chatushringi, Kalas near Lon-	
	avala.	
L. marrinicensis (SW.) R. Br	Sinhagad	
L montana Spr	Sinhagad, Panchgani	
L. stelligera Wall	Lohagad, Torna, Malvali to	
•	Bhaja.	
Leonotis neoaefolia R. Br	Law College Hill, Pune	
Nepcta hindustana (Rotn) Haines	Sinhagad	
=N. ruderalis Buch. Ham		
Solanaceae:	Malvali to Bhaja, Sinhagad	
S. indicum L	Transmit to minim, pinningun	

bolmin .	IND I BORN
S. nigrum L	Mutha river, Torna, Sinhagad, Panchgani.
S. xanthocarpum Schard. and Wendl.	Talegaon, Yeravda
Physalis peruviana L Nicandra physalioides (Linn.) Gaertn.	Cultivated at Panchgani Sinhagad, Ganeshkhind
Datura fastuosa L D. stramonium L	Ganeshkhind Yeravda
Scrophulariaceae:	Cintornal
Verhascum coromandelianum (Vahl.)	Sinhagad
=Celsia coromandeliana Vahl. Kuntze.	Torna, Vitthalwadi, Chatushringi
Kickria incana (Wall.) Penn K. ramolissima (Wall.) Janchen	Law College hill and Hostel Chatushringi
=Linaria ramocissima Wall	Katraj, Vetal hill
Lindernia indica (Linn.) O. Kuntze =L. urticaefolia Lehm.	Sinhagad
Lindernia hyssopoides (Linn.) Haines	
=Ilysanthes hyssopioides Benth. L. parviflora (Roxb.) Haines.	Sinhagad
=I. parviflora Benth.	
Veronica anagallis Linn. Buchnera hispida Buch, Ham	Sinhagad, Rajgad Torna, Malavli to Bhaja, Sinha-
- Contraction of the Contraction	gad, Law College hill.
Striga densiflora Benth. S. euphrasioides Benth.	Chatushringi, Kalas near Lonavala Law College hill
S. euphrasioides Benth. S. gesneroides (Willd.) Vatke.	Chatushringi
=S. orobanchoides Benth	Sinhagad
S. lutea Lour	Chatushringi, Kalas near Lona-
Rhamphicarpa longifolia Benth	vala, Torna. Torna
Sopubia delphinifolia (Roxb.) G.	Vitthalwadi, Chatushringi, Kalas
Don. S. trifida Buch Ham.	Torna, Panchgani, Sinhagad
·	,,
Bignoniaceae: Oroxylum indicum Vent	Ganeshkhind, Katraj
Millingtonia hortensis Linn. f	Yeravda
Dolichandrone faleta Scen	Chatushringi, Bhamburda, Law College hill.
Heterophragma quadrilocularis	Malavli
(Roxb.) Schum. =H, roxburghii DC	Torna Phamburda Chatushainai
=H, roxburghti DC. Stereospermum tetragonum DC.	Torna, Bhamburda, Chatushringi Bhamburda
=S. chelonoides Cl.	Considering Water 1991 Value
Tecoma stans Juss	Ganeshkhind, Vetal hill, Katraj
Martyniaceae:	D. W.
Martynia annua L	Pune, Katraj Sinhagad
-	
Gesneriaceae: Aeschynanthus perottetti A. DC.	Visapur
Acanthaceae: Thumbergia alata Boj	Visapur fort

Blepharis asperrima Nees	Torna, Malavli to Bhaja,		
	Sinhagad.		
B. molluginifolia Pers.	Law College hill		
Asteracantha longifolia Pers	Do.		
Hygrophila serpyllum (Nees.) T. And.	Sinhagad, Torna		
Ruellia patula Jacq	Kalas near Lonavala, Law College hill.		
R. tuberosa L	Empress Garden, Pune		
Hemigraphis latebrosa Nees var. heyneana Bremek.	Sinhagad, Torna, Malavli to Bhaja.		
Calophanes dalzellii T. And	Law College hil!		
Eranthemum roseum (Vahl.) R. Br.	m N.E. L. dl. A. Thillada		
= Daedalacanthus roseus T. And.	Torna, Malavli to Bhaja, Sinhagad.		
Andrographis echioides Nees	Law College hill, Kalas near Lonavala.		
Carvia callosa (Wall.) Bremek.	Sinhagad, Torna, Lohagad		
Strobilanthus ixiocephalus Benth.	Panchgani, Rajgad		
Haplanthus tentaculatus Nees	1 4 , 1y		
H. verticillaris (Roxb.) Nees	Sinhagad		
Barleria cristata L	11.1		
B. lawii T. And	Torna, Sinhagad		
Asystasia violacea Dalz.	24.5 T		
Lepidagathis cristata Willd	Kalas near Lonavala, Vetal hill, Law College hill.		
L. cuspidata (Wall.) Nees	Sinhagad		
L. mitis Dalz	Sinhagad		
L. trinervis Nees var. asperrima:	Talegaon		
Rungia parviflora Nees	Empress garden, Pune		
Rungia pectincita (Linn.) Nees var. pectinata Clarke.	Sinhagad		
R. repens (Linn.) Nees	Sinhagad, Law College hill		
Justicia betonica Linn	Torna		
J. diffusa Willd.			
.	Lonavala, Chatushringi Sinhagad, Panchgani		
J. procumbens Linn	Kalas near Lonavala		
J. quinqueangularis Koen	Torno Dune Law College hill		
J. simplex D. Don	Torna, Pune Law College hill Sinhagad, Torna, Visapur		
Adhatoda vasica Nees	Near Sinhagad		
Peristrophe bicalyculata (Retz.)	17041 Dimitagao		
Dubicces :			
Rubiaceae: Mitragyna parvifolia Korth	Sinhagad		
Dentella repens Forst.	Vitthalwadi		
Oldenlandia aspera DC	Kalas near Lonavala, Ganesh- khind, Law College hill.		
O. corymbosa L	Chatushringi, Panchgani, Law College hill.		
O. herbacea (Linn.) Roxb.	Sinhagad		
Anotis foetida Benth and Hook. f.	Law College hill		
A. montholoni Hook. f	Kalas near Lonavala, Chatushringi,		
A. Montholom Hook, I	Ganeshkhind.		
Randia brandisii Gamble	Lohagad		
= R. tomentosa W. and A			
R. dumetorum Lamk	Chatushringi, Lohagad, Visapur		
41. Million Charles Tarretter	Torna, Law College hill.		
Gardenia turgida Roxb	Vetal hill		

Meynia laxiflora Robyns = Vangueria spinosa Auct. = Xeromphis spinosa	Sinhagad Malavli to Bhaja			
Ixora parviflora Vahl	Visapur			
Hamiltonia suaveolens Roxb	Sinhagad, Torna			
Morinda citrifolia Linn	Chatushringi			
M. tinctoria Roxb	Chatushringi, Law College hill, Katraj.			
M. tomentosa Hook. f	Newasa in District Ahmednagar			
Borreria hispida K. Sch	T 27 11 1 111			
=Spermacoce hispida Linn				
B. stricta K. Sch.	Way to Lohagad			
=Sp. strictus Linn. f	Torna, Chatushringi, Sinhagad,			
n to term	Kalas near Lonavala.			
Rubia cordifolia L	Torna, Visapur			
Cucurbitaceae :	O' 1 1			
Bryonopsis laciniosa Naud	Sinhagad			
Cucumis callosus (Rottl) Cogn = Bryonia callosa Rottl.	Sinhagad			
Cucumis melo Linn, var. agrestis	Sinhagad, Panchgani			
Naud.	Simagau, Panengani			
C. trigonus Roxb.	Balapur			
Citrullus colocynthus Schard.	Between Shevgaon and Babhul-			
om and conceptional Bollara.	gaon (District Ahmednagar).			
Coccinia indica W. and A	Kalas near Lonavala			
Cucurbita maxima Linn	Visapur, Torna, Yeravda			
Corallocarpus epigaeus Clarke	Chatushringi			
VAU				
Campanulaceae:	707			
Cephalostigma schimperi Hochst.	Sinhagad			
C. flexuosum Hook. f. and Th	Torna			
Campanula alphonsoi Wall.	Sinhagad			
Lobelia heyneana R. and S.	Sinhagad			
=L. trialata Buch. Ham.				
L. nicotianaefolia Heyne	Torna, Visapur, Lohagad			
Compositae:				
Centratherum phyllotaenum (DC.)	Sinhagad			
Benth.				
C. tenue Clarke	Sinhagad, Panchagni			
Lamprachaenium microcephalum	Sinhagad			
Benth.	Low College trade Water			
Vernonia cinerea (Linn.) Less.	Law Colle ge hostel, Kalas near			
Adenostemma viscocum Forst	Lonaval a, Sinhagad Panchgani			
Ageratum conyzoides L	Panchgani, Sinhagad, Torna,			
Ageraiant cony 20taes D.				
Dichrocephala latifolia DC	Lohagad Chatushringi			
	Lohagad, Chatushringi.			
	Lohagad, Chatushringi. Sinhagad			
Cyathocline purpurea(Don.)O.Ktze.	Lohagad, Chatushringi. Sinhagad			
Cyathocline purpurea(Don.)O.Ktze.	Lohagad, Chatushringi. Sinhagad Sinhagad, Malavli to Bhaja.			
Cyathocline purpurea(Don.)O.Ktze.	Lohagad, Chatushringi. Sinhagad Sinhagad, Malavli to Bhaja, Torna, Parner (District Ahmednagar).			
Cyathocline purpurea(Don.)O.Ktze.	Lohagad, Chatushringi. Sinhagad Sinhagad, Malavli to Bhaja, Torna, Parner (District Ahmednagar). Sinhagad, Panchgani, Torna.			
Cyathocline purpurea(Don.)O.Ktze. =C. lyrata Cass	Lohagad, Chatushringi. Sinhagad Sinhagad, Malavli to Bhaja, Torna, Parner (District Ahmednagar). Sinhagad, Panchgani, Torna, Malavli to Bhaja, Raigad.			
Cyathocline purpurea(Don.)O.Ktze. =C. lyrata Cass. Conyza stricta Willd. Blumea malcolmi (Clarke) Hook. f.	Lohagad, Chatushringi. Sinhagad Sinhagad, Malavli to Bhaja, Torna, Parner (District Ahmednagar). Sinhagad, Panchgani, Torna, Malavli to Bhaja, Rajgad. Torna, Sinhagad, Panchgani			
Cyathocline purpurea(Don.)O.Ktze. =C. lyrata Cass	Lohagad, Chatushringi. Sinhagad Sinhagad, Malavli to Bhaja, Torna, Parner (District Ahmednagar). Sinhagad, Panchgani, Torna, Malavli to Bhaja, Raigad.			

Vicoa indica (Willd) DC	Torna		
=V. auriculata Cass	Chatushringi, Pune, Kalas near		
V. cernua Dalz	Lonavala, Law College hill. Torna, Sinhagad		
Pulicaria wightiana DC	Chatushringi, Pune, Law College,		
	hill, Kalas near Lonavala.		
Caesulia axillaris Roxb	Kalas near Lonavala, Pune, Law		
TE ALL AND T	College hill, Chatushringi.		
Xanthium strumarium L	Yeravda, Law College hill, Pune		
Lagasca mollis Cav	Ganeshkhind, Sinhagad, Law College hill.		
Acanthospermum hispidum Don.	Sinhagad, Law College hill		
Siegesbeckia orientalis (Linn.) Hassk.	Malavli to Bhaja, Yeravda		
Eclipta alba (Linn.) Hassk	Malavli to Bhaja		
=E, erecta Linn	Yeravda		
Blainvillea latifolia (Linn. f.) DC.	Sinhagad		
=B. rhomboidea Cass	Law College hill		
Guizotia abyssinica Cass	Sinhagad, Malavli to Bhaja		
Guizotia tinctoria Cass	Torna		
Glossocardia linearifolia Cass	Kalas near Lonavala, Sinhagad Chatushringi hill.		
Bidens biternata Merr. and Sheriff.	Torna		
=B. pilosa Auct	Torna, Malavli to Bhaja, Sinhagad, Law College hill.		
Tridax procumbens L	Katraj, Law College hill		
Flaveria contrayerba Pers	Ganeshkhind, Kalas near Lona vala, Deccan in poor soils.		
(0)	Sinhagad.		
Artemisia nilagirica (Clarke)	Pamp.		
=A. vulgaris L	Sinhagad		
Gynura angulosa DC	Sinhagad, Panchgani		
Emilia sonchifolia (L.) DC	Torna, Malavli to Bhaja, Sinhagad.		
Notonia grandiflora DC	Katraj, Panchgani		
Senecio edgeworthii Hook. f	Torna, Sinhagad		
S. gibsoni Hook. f	Sinhagad		
Echinops echinatus DC	Ganeshkhind, Chatushringi, Torna, Law College hill.		
Tricholepis amplexicaulis Clarke	Sinhagad		
T. radicans DC	Chatushringi, Kalas near Lona vala, Torna, Law College hill.		
Carthamus tinctorius L	Sangam bridge		
Dicoma tomentosa Cass	Law College hill		
Lactuca runcinata DC	Law College hill		
Sonchus arvensis Linn	Chatushringi, Law College hill		
S. asper Hill	Sinhagad		
S. arvens Linn	Chatushringi, Law College hill		
S. oleraceus Linn	Sinhagad		
Launaea nudicaulis Less	Chatushringi, Kalas near Lonavala		
Zinnia elegans Jacq	Ganeshkhind		
-			

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0.5 FLORA OF NASIK DISTRICT

5.1. Lopography, Climate and Soil:

This is a dry district having undulating surface, except in Malegaon, Sinnar, Yeola and partly in Nandgaon and Niphad talukas. The latter are plain and lie in the basin of various rivers and streams. The larger rivers Godavari, Girna and Vaitarna rise from Sahyadris and flow through this district. The peak line of Sahyadris forms the water shade between Vaitarna and Darna river system.

Physiographically there are four major regions of the district :-

- 1. Konkan tract down the ghats and peaks.
- 2. Girna basin
- 3. Godavari basin, and
- 4. Surgana adjacent to Sahyadri ranges.

Agriculturally valleys through which the rivers flow are important as the major crops are grown there. Topography is rugged in regions close to Sahyadris. The soils are light. The rainfall in the four regions is different. It is heavy in regions next to Sahyadri ranges and decreases towards east. There is fairly good irrigation in the regions which are in plains, mainly in Girna basin. The soils here are light and reddish brown in many places, but they are alluvial where the big rivers like Godavari, Girna flow e.g. in Nasik, Malegaon, Niphad and Manmad. Yeola has black cotton soils. In Igatpuri and in ghat region the soil is light and gravelly.

The whole district is derived from Deccan traps. There is no lateritic soil on the summits of Sahyadri mountain here as in other places. This is rather unusual.

Climate.—It is generally dry and variable. The annual rainfall also is variable. The average annual rainfall for the whole district is 40.73" or 1034.5 mm. However in the region of the ghats and those in close proximity of Sahyadri, it is heavier e.g. in Peint in the north, it is 2351.6 mm (92.58"). At Igatpuri towards south it is 3341.6 mm (131.56"), at Dindori it is 753.1 mm and at Satana 477.3 mm. Igatpuri is the wettest part of the district. Variations from year to year are considerable. Once in two years out of 3-4 consecutive years, the rain is only 80% of the normal. Niphad has low rainfall. On an average there are 51 rainy days, at Peint they are 89, at Igatpuri 102, at Satana 32 and at Dindori 54.

Temperature.—Malegaon has the highest temperature in summer —40.6°C. Heat is intense particularly in plains. Humidity is high (80%) in monsoon, but only 20 to 25% in other seasons. The forest area belonging to Forest department is 3338.85 km² or 1289.13 sq. miles. All the regions in plains however are intensively cultivated. There are no forest based industries. The only industry is that of timber, firewood, charcoal and bamboos. On the north-west side the district opens into Dangs in Gujarat. Many plantations of teak and Eucalyptus are being raised by the Forest department in different areas for soil conservation and plant products.

Flora and Vegetation.—The flora of the district has not been fully described. Only stray observations have been made by workers on the flora of Tryambakeshwar, Vani (Saptashringi), Nasik, Surgana, Harsul and Igatpuri. The common cereal crops are Bajra in dry regions whereas tobacco, chillies, onion, and sugarcane are cultivated in regions abounding in water and having black cotton soils at Niphad, Yeola, Pimpalgaon Baswant, Malegaon and partly in Satana. There is shifting in the district, on account of which the Forest department is put to heavy loss.

Tryambakeshwar close to Nasik is a dry hill and supports sparse vegetation and dry scrub, despite the heavy rainfall 2456 mm compared to many other places. The list of plants there clearly shows dry deciduous nature of the vegetation. There is only dry scrub on top of Brahmagiri

plateau where surprisingly only a few stunted trees of Ficus glomerata, Terminalia chebula, Semecarpus anacardium and some bushes grow.

Average Annual Rainfall

	(in mm)
• •	696.0
Tryambakeshwar	
	3341.6
	557.6
	555.3
	584.7
	542.5
***	477.3
	753.1
	2351.6
	1034.5

The plants here suffer from extremes of rain, heavy winds, heat and soil erosion.

Bamboo brakes form good stands on the slopes and in plains below the foot of mountain ranges. The high plateau of Tryambakeshwar though receives heavy rains for three months, it becomes quite dry for want of rains and humidity for the rest of nine months of a year.

The vegetation, therefore, forms southern tropical deciduous forest of the poor type. Possibly the vegetation in earlier days was richer and better, but has now degraded into dry deciduous scrubby type. This is indicated by the list of plants at Tryambakeshwar also.

Another area from which the plants are known is Vani and Saptashringi in Dindori taluka. Plants of this place have been studied by Prof. P. B. Vaidya of H. P. T. College, Nasik and described by Cherian and Pataskar (1969) in Bull. Bot. Surv. India, Vol. 11 (102): 22—34. The list of plants collected (given separately) clearly shows the vegetation of semi-arid type. The rainfall at Vani is medium, but the temperature is relatively high. The soil is poor, gravelly and not fertile.

The third area with good vegetation is Igatpuri having high rainfall. It has a ghat leading to Bombay. Here also the rains though heavy, water rushes down the hills and they have no vegetation. They look barren except for the ghat section where it is preserved in the valleys. It is of monsoon deciduous type with *Tectona grandis* as the major economic species. The trees however do not have very wide girth and yield mostly bullis or poles.

The fourth area of which flora is better known is Surgana-Harsul area bordering on the Dangs of Gujarat. It is close to Sahyadri ranges. It includes hill tops, valleys and slopes of Surgana range. Surgana once a small State is now a taluka in Nasik district. Harsul is close to Surgana. Both places are quite rich in plants. They have dry deciduous forests in which Tectona grandis predominates.

Cherian and Pataskar (1969) have had collected here 403 species belonging to 83 families of flowering plants and 5 pteridophytes. The first three families are Compositae (Asteraceae), Leguminosae (Fabaceae), and Gramineae (Poaceae).

Usually the hill tops of Sahyadris in this area are barren or have poor vegetation as in Igatpuri hills. Soil is lateritic, rainfall is 120—130% and maximum temperatures 30°—40° C. Soon after monsoons, rain water is drained off into valleys. The tops and slopes suffer from water scarcity for 8 months. Dew is formed in valleys in cold season and in low lying areas.

The important plant species are Terminalia chebula, Terminalia crenulata T. bellerica, Tectona grandis, Adina cordifolia, Dalbergia lanceolaria and shrubs like Mallotus phillippinensis, small trees of Macaranga peltata. Several herbs and grasses spring in monsoons. There is distinct ephemeral flora made up of Composites like Senecio and legumes like Smithia, Aroids like Amorphophallus commutatus, Ariopsis peltata, Arisaema murrayi etc. The vegetation here is obviously similar to that of valleys and hill tops of Sahyadris elsewhere e. g., Panchgani, Tryambak, but being close to Dangs in Gujarat, it contains also species common to that area. In spite of high rainfall, vegetation is sparse and hills barren. The vegetation in valleys is similar to that in Peint, Chikhaldara, and is composed of the similar species.

Only vegetation in plains is along the banks of large rivers like Godavari, Girna and smaller rivers like Darna and other streams. It is largely dominated by Acacia arabica, Syzygium cumini, Morus alba and Bauhinia purpurea. It does not represent climatic climax but post-climatic stage. In open or cleared areas species of bamboos and Lantana camara grow abundantly. On the whole the vegetation of Nasik district consists of mostly dry deciduous forest or scrub, with no rich dense forests except in Peint and Surgana talukas in valleys.

सन्धमन जयत

The plants of these four places are considered below.

5.2: Plants of Tryambakeshwar Hills:

Tryambak or Tryambakeshwar lies at 73°.13—73°.30 E and 19°.54—19°.56 N. It is an important area from the view point of plants. It suffers from high rainfall, winds and erosion, notwithstanding its close proximity to Sahyadri ranges. The plateau on top of the range here is about 4.8 km from main range of Sahyadris. The place is very near to Nasik, 28.3 km distant. It is a very famous place of pilgrimage on account of the temple of Tryambakeshwar, which like Bhimashankar is one of the holy twelve Jyotirlingas of Lord Shiva. The temple and the town is 2448' above MSL and was built by the third Peshwa Balaji Bajiray (1740-1761). The river Godavari is sacred to Maharashtra and Andhra people. It takes its origin here from a small cave on the top of the hill called Brahmagiri about 2808' high, and 3.8 km distant from the Brahmagiri plateau is on the top of the hill. main range of Sahyadri. This hill like all hills around becomes dry after December due to rising temperature, high winds and low humidity. The vegetation consequently is of the dry deciduous type in spite of high rainfall.

The conspicuous important plant that forms sparse stands is Tectona grandis. On the top of the plateau occur Terminalia bellerica, Capparis aphylla, Butea monosperma bushes of Pogostemon parviflorus, Adhatoda vasica, Woodfordia fruticosa, Barleria sp. By the stream side Polygo-

num glabrum, Mentha viridis, Clematis gauriana, Vitis quadrangularis are scen. On the slopes of hills Dalbergia sissoo, Daemia extensa, Rhus mysurensis are seen. On the plateau and in shady places some ground orchids belonging to the genus Habenaria, and on trees Dendrobium plants grow. In the lower parts of valleys Combretum ovalifolium is frequently seen.

In the valleys the vegetation is better. It is however not so rich as that on Konkan side. In places there are moist deciduous forests. They contain Anogeissus latifolia, Tectona grandis, Terminalia arjuna, Syzygium cumini, Semicarpus anacardium, Garuga pinnata, Boswellia serrata. The small bushes of Carissa congesta, Calycopteris floribunda surround them in moist places, but in dry places Acacia leucophloea only grow.

Clumps of *Dendrocalamus strictus*, *Lantana camara* are there, but not frequent. Eight months being rainless humidity is low and only dried grass is seen. It does not make good pasture, but holds the soil surface well. Carpets of herbaceous plants and grass appear soon after the monsoons and form ephemeral flora. Hills of Tryambakeshwar, Saptashringi, Igatpuri, Kasara ghat have nearly the same sort of vegetation, representative of dry hills with heavy rainfall, poor soil and low humidity after the rains.

The list given here is compiled from the collection made by Prof. P. B. Vaidya (1969) and Dr. D. R. Mahajan (1978). On these hills Sapindus laurifolius, Prosopis spicigera, Acacia catechu, Albizzia lebbeck, Dalbergia sissoo, Rhus mysurnsis, Barleria cristata, Woodfordia fruiticosa, Adhatoda vasica are seen on the hill top, but disappear as we go higher. Creepers of Combretum ovalifolium, Clematis gauriana, Hoya carnosa, Tinospora cordifolia are seen on small trees, especially Acacia arabica. Orchids Dendrobium sp. and Aerides crispum grow epiphytically on trees on western side of the hill.

Mixture of dry xerophytic species such as *Prosopis spicigera* with ground orchids and tuberous plants on western side is noteworthy.

Plants at Tryambakeshwar and Hills Around

(after P. B. Vaidya and D. R. Mahajan)

Ranunculaceae: Clematis gauriana

Menispermaceae:
Tinospora cordifolia

Anonaceae:

Anona squamosa

Capparidaceae:
Capparis aphylla
Cleome simphicifolia

Labiatae:

Pogostemon parviflorus
Ocimum sanctum

Portulaceaceae:

Portulaca oleracea
A-127-45-A.

Cyperaceae:
Cyperus rotundus

Zygophyllaceae:
Tribulus terestris

Rutaceae:

Pervia elephantum

Amaranthaceae:
Amaranthus spinosus

Meliaceae:

Melia azadirach

Rhamnaceae: Zizyphus jujuba

Vitaceae :
Evolvulus alsinoides

Sapindaceae:
Sapindus laurifolius

Anacardiaceae:
Rhus mysurensis
Mangifera indica

Moringaceae:

Moringa species

Papilionaceae:
Erythrina indica
Indigofera tinctorea
Pongamia glabra

Caesalipirnaceae:
Caesalpinia bonducella
Tamarindus indica
Albizzia lebebk

Mimosaceae:
Acacia arabica
Prosopis spicigera
Mimosa pudica

Combretaceae : Terminalia arjuna Combretum ovalifolium

Myrtaceae :
Syzygium cumini
Eucalyptus hybrida

Punicaceae:
Punica granatum

Lythraceae:
Woodfordia fruticosa
Lawsonia alba

Umbeliferae:
Centella asiatica
A-127—45-B.

Compositae:
Lagasca mollis
Tagetes patula

Rubiaceae:

Ixora brachiata

Sapotaceae:
Mimusops elengi

Apocynaceae:
Plumeria acutifolia
Thevetia species
Rauwolfia serpentina

Oleceae: Jasminum sp.

Asclepiadaceae:
Calotropis procera
Asclepias curasavica
Hoya carnosa

Boraginaceae: Cordia mixa

Solanaceae:
Solanum indicum

Convolvulaceae: Ipomoea palmata

Acanthaceae:
Adhatoda vasica
Barleria cristata
Justicia species

Verbenaceae:
Duranta plumeriana
Tectona grandis
Vitex negundo

Amaranthaceae: Celsia argenteana

Chenopodiaceae: Chenopodium alba

Polygonaceae: Polygonum species

Euphorbiceae:
Euphorbia hirta
Euphorbia geniculata
Euphorbia antiquorum
Euphorbia tirucalli
Pedilathus tithymeloides
Phyllanthus emblica
Jatropha gossypifolia

Orchidaceae:

Dendrobium species (Ground orchid)

Aerides crispum (Epiphytic)



Commelina begalensis

Gramineae:

Setaria glauca Eleusine indica Dendrocalamus strictus

5.3. Plants of Igatpuri (Kasara) Ghat:

Igatpuri, lies at the entrance of a pass, 607 m above the M. S. L. or 1992', on the main line of Central Railway. It is a hill station. The climate is cool and equable. The average mean annual temperature is 25° C. The rainfall is high 3341.6 mm. Rainy days in the year are 101. The rainfall varies from 2032 mm. to 2667 mm. or 80-105". Naturally one expects much more cool weather, but it is not so, as after the rainy season heat emanates from the surrounding denuded hills during day time. However it cools down in the evening, and nights are quite cool. There is not much humidity in air after monsoons, and the place becomes very dry. Kasara ghat leading to Bombay and Harishchandra ranges are more like ghats on west side of Sahyadris.

Dominant tree species are Tectona grandis and Adina cordifolia mostly in the valleys. Many trees of Eucalyptus have been planted by the Forest Department, but in the hard denuded areas devoid of soil, they do not seem to prosper well. In the midst of Kasara ghat and in ghat leading to Kalasubai via Ghoti, one sees bushes of Lasiosiphon eriociphalus, Elaegnus conferta, Barleria involucrata, Allophyllus cobbe, Carissa congesta, Euphoriba neridifolia, Lobelia nicotianaefolia etc. Many herbaceous species such as Heracleum concanense, Pusedinum grande, Senecio dalzelli, grasses like Heteropogon, Apluda grow abundantly. On the escarpments at high level Terminalia cremilata, Lagerstroemia lanceolata, Dalbergia lanceolaria, Bridelia retusa, Ixora brachiata, Glochidion hohenackeri, Schleichera trijuga are common. In places in the lower reaches of ghats, one sees Ceiba malabarica. On the outskirts of ghat forest Calicopteris floribunda, Combretum ovalifolium Diospyros montana and Holarrhena antidysenterica are noticed. Tectaria maerodenta is a common fern on forest floor. The open spaces have monsoon ephemerals, but with some temperate species.

The flora and vegetation here are essentially of the same type as in other ghats, but rather dry and poor. The vegetation except in the valleys is mixed dry deciduous. The trees of *Tectona grandis* are tall. They mostly make poles. They do not form good timber as those in Thane district forests. The poor soil, lack of humidity and water, emanation of heat and quick loss of water from mountain slopes are responsible for it.

5.4. Flora of Saptashringi Hills:

The flora of this famous place has been studied by Prof. P. B. Vaidya of H. P. T. College, Nasik and by Dr. P. J. Cherian and R. D. Pataskar (1969). The latter's observations have been published in Bull. Bot. Surv. India, 11 (1 and 2):23—34, 1969. The hill is seven-horned or seven crested. The species of angiosperms here were collected by Prof. P. B. Vaidya in rainy season and in late winter and therefore, his list is given separately. He collected 160 species belonging to 53 families, while climbing the nill from Dindori side. It contains many herbaceous species that were not collected by Cherian and Pataskar (1969). Their collection was made in rainy season.

Saptashringi lies between 73°51'-73°58' E and 20°20'-20°27' N. It is about 64 km from Nasik. It is the seat of Saptashring Nivasini Devi, sacred to all Hindus, particularly from Nasik, Jalgaon, Dhule and Ahmednagar Districts.

The altitude of the place is 1420.06 metres. It is surrounded by other peaks, the prominent among which is Markunda 1461 m high. There is a broad plateau at the top, the topmost part being a sharp scarp. The Dattatreya temple is a little below the Devi temple on the topmost point. The middle part of the hill is a barren rock formed by the Deccan trap. It forms coarse gravelly soil. The hill lies a little in the interior, off the main Sahyadri range on a lateral spur extending from Chandwad eastwards. The vegetation is mostly on the lower part of the hill and in the valleys where soil is better. On the upper part of the hill the soil is brown, but in the valleys it is black. The hill tops have scarcely any soil as they are eroded due to high winds and rains. Only a few trees and shrubs occur on the high slopes and in valleys. The climate like that of many parts of Nasik district is dry for 8 months of a year. Rainfall is very high, mostly from June to September. Daily mean temperature maximum 31°.1 C and minimum 16°.9. Relative humidity is 69.07%.

Vegetation.—The vegetation is of dry deciduous type, largely governed by the topographic, edaphic and human factors. They have greatly affected the vegetation here. On the eastern side near Daregaon there is Daityacha Dongar. There is some forest, but not dense as the edaphic factors seem to operate severely on the area. The vegetation on the slopes on eastern and western sides of Saptashringi hill, Markunda hill, is covered by Tectona grandis, Anogeissus latifolia, Terminalia crenulata plant community, mostly at the foot of these hills. Above 600 m the vegetation changes. On the west side it becomes xerophytic. Here and there, there are trees of Terminalia crenulata, Boswellia serrata, Garunga pinnata, Dalbergia lanceolaria, Lannea coromandelina, Anogeissus latifolia, Lagerstroemia parviflora, Bridelia squamosa, Bombax ceiba, Butea monosperma etc. Their growth however is neither profuse nor poor. It is medium.

On open exposed slopes Lantana camara var. aculeata, Acacia nilotica Zizyphus mauritiana are formed side by side with Bidens pilosa and Cassia absus. Bushes of Diospyros melanoxylon, Ougenia ougenioides and some grasses grow simultaneously. A few plants of Glochidion hohenackeri, Xeromphis spionsa, Holarrhena antidysenterica, Syzygium cumini occur in moist protected places. Several grasses like Themeda quadrangulaire, Apluda mutica, Arundinella pumila, Cymbopogon martini, Heteropogon contortus, Eragrostis pilosa grow abundantly. On the forest floor in shade grows a fern Tectaria species as a common undergrowth. Many woody creepers Aspidopteris cordata, Dioscorea pentaphylla, D. bulbifera, Dragea volubilis, Rivea hypercrateriformis are found growing on trees and bushes in the forest. A few herbaceous climbers such as Coceullus hirsutus, Mukia maderaspatana are also found.

After the middle part of the hill, vegetation becomes thorny, dry and sparse. Euphorbia neriifolia, Aerua leucacephala, Carisse congesta become dense with bushes of Neuracanthus and Bidens pilosa. This is a transitional zone and bushes of Glochidion hohenackeri and Trema orientalis get mixed with xerophytic species of scrub.

During monsoons ephemeral flora appears on flat plains and plateaus on the small and large hill flats. It consists of Biophytum sensitivum, Heylandia latebrosa, Crotalaria mysureneis, Alycicarpus vaginalis, Smithia purpurea, Commelina and Justicia species.

High peaks of Saptashringi and Markunda do not have any trees or even shrubs. They support only grasses such as Setaria glauca and a few others. In the ledges of rocks and on moist vertical cracks and crevices some soil accumulates and Senecio grahami, Anotis latifolia, Evolvulus alsinoides, Justicia simplex, Cassia pumila and grasses grow in rainy season. Even on very small platforms Senicio grahami, Crotalaria prostrata, Dysophylla stellata, Exacum bicolor, Exacum pedunculata, Linderina sessilis, Impatiens dalzellii, Impetiens cleinei, Striga densiflora, Utricularia uliginoides, Eriocaulon species grow. Ground orchids like Habeinaria rariflora grow in the midst of dense small grass. With the onset of monsoons many tuberous plants like Iphigenia indica, Chlorophytum glaucum, Hypoxis orea, Curculigo orchioides, Cynotis fasciculatus, Impatiens balsamina begin to grow and come in full bloom by about August forming showy carpets.

Cherian and Pataskar (1969) visited the hill after monsoons, and were able to collect 245 species belonging to 68 families of angiosperms. Important among them are given separately.

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Flora of Saptashringi (Vani):

Plants enumerated by Prof. P. B. Vaidya.

Ranunculaceae:

Clematis gouriana Roxb. Clematis triloba Heyne ex Roth

Magnoliaceae:

Michelia champaca Linn.

Anonaceae:

Anona squamosa Linn.

Menispermaceae:

Cyclea burmanni (DC) Hook F. and Roth Cissampelos pereira Linn.
Cocculus hirsutlus (Linn.) Diels

Papaveraceae:

Argemone mexicana Linn.

Cruciferae:

Cardamine trichocarpa Hoehst

Polygalaceae:

Polygala persicarifolia DC

Portulacaceae:

Portulaca oleracea Linn.

Malvaceae:

Sida acuta Burm. f.
Sida acuta var. retusa
Urena lobata Linn.
Hibiscus rosa-sinensis Linn.
Tl.espesia populnea (Linn.) Sol. ex Cerr.

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Bombacaceae:

Salmalia malabarica (DC) Sch.

Tiliaceae:

Triumfetta rhomboides Jacq.

Linaceae:

Linum mysurense Heyne ex Benth

Oxalidaceae:

Oxalis corniculata Linn.

Balsaminaceae:

Impatiens balsamina Linn.

I. balsamina Linn. var. corymbosa sant.

I. oppositifolia Linn.

I. acaulis Arn.

Meliaceae:

Melia dubia Hiern Azadirachta indica A. Juss.

Celastraceae:

Gymnosporia rothiana Laws

Rhamnaceae:

Zizyphus rugosa Lamk.

Anacardiaceae:

Mangifera indica Linn.

Fabaceae-Papilionaceae:

Heylandia latebrosa DC.

Crotalaria nana Burm. f.

Indigofera enneaphylla Linn.

I. glandulosa Roxb.

1. cordifolia Heyn ex Roth

1. lineafolia (Linn. f.) Retz.

Smithia conferta Sm.

S. purpurea Hook.

S. setulosa Dalz.

Alysicarpus tetragonolobus Edgew.

A. rugosus (Willd.) DC.

A. vaginalis (Linn.) DC.

Ternamnus ladiaris (Linn. f.) Spreng.

Zornia diphylla (Linn.) Pers.

Erythrina stricta Roxb.

Butea monosperma (Lamk) Tall.

Vigna radiata (Linn.) Wikz.

Vigna vexillata (Linn.) A. Rich.

Vigna capansis Walp.

Phaseolus radiatus (Linn.)

P. aconitifolius Jacq.

Dolichos biflorus Linn.

Atylosia scabraecides (Linn.) Benth.

Cylista scariosa Roxb.

Caesalpineaceae:

Cassia pumilla Lamk.

Bauhinia racemosa Lamk.

Mimosaceae:

Albizzia amara (Roxb.) Beivin Acacia intsia Willd.

Combretaceae:

Terminalia crenulata Roth Anogeissus latifolia Bedd

Myrtaceae:

Syzygium cumini (Linn.) Skeels

Lythraceae:

Ammannia multiflora Roxb. Woodfordia fruticosa (Linn.) Kurz

Begoniaceae:

Begonia cencanensis DC.

Umbelliferae:

Pimpinella tomentosa Dalz. Heracleum conkanense Dalz.

Rubiaceae:

Oldenlania herbacea Roxb. Anotis lancifolia Hook. f. Anotis foetida (Dalz.) Lewis Borreria stricta K. Sch.

Compositae:

Pavetta indica Linn. Centratherum phyllolaenum (Bth.) ex Hook. f. Benth. Ageratum conyzoides Linn. Cyathocline purpurea (D. Don) Kuntze Eclipta prostrata (Linn.) Linn Eclipta alba (Linn.) Hassk. Bidens biternata (Lour.) Merr. and Sherrif Vicoa indica DC. Tridax procumbens Linn. Xanthium strumarium Linn. Artemesia nilagirica (C. B. Cl.) Pamp. Gynura angulosa DC. Emilia sonchifolia DC. Senecio grahami Hook. f. Guizotia abyssinica Cass Acanthospermum hispidum DC.

Plumbaginaceae:

Plumbago zeylanica Linn.

Oleaceae:

Olea dioica Roxb.

Apocynaceae:

Wrightia tinctoria R. Br. Carissa congesta W. f. Nerium indicum Mill

Genteniaceae:

Swertia minor (Griseb) Knobl.

Boraginaceae:

Trichodesma amplexicaule Roth. Cynoglossum wallichii D. Don Cynoglossum glochidiatum Wall. Adelocaryum coelestinum (Linn.) Branch.

Convolvulaceae:

Ipomoea nil (Linn.) Roth. Argyreia sericea Dalz. Cuscuta reflexa Roxb.

Solanaceae:

Solanum indicum Linn. Nicandra physaloides (Linn.) Gaertn.

Scrophulariaceae:

Bacopa monieri (L.) Pennell.
Kickxia ramosissima (Wall.) Junchen.
Linaria remosissima Wall.
Lindernia ciliata (Colsm) Pennell
Rhamphicarpa longiflora (Arn.) Benth.
Sopubia delphinifolia D. Don.

Lentibulariaceae:

Utricularia striatula Sm. U. uliginosa Vah.

Acanthaceae:

Asteracantha longifolia Nees.
Asystasia dalzelliana Santapau.
Justicea simplex Don.
Rungia repens (L.) Nees.
L. pidagathis cristata Willd.

Verbenaceae:

Lantana camara Linn. Tectona grandis Linn. f. Vitex neguno Linn. Clerodendren serratum Linn.

Labiatae:

Plectranthes mollis (Ait.) Sprang.
Pogostemon benghalense (Burm.) Kunge.
Pogostemon plectranthoides Des.
Colebrookea oppositifolia Sm.

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Nyctaginaceae:

Boerhaavia diffusa Linn.

Amaranthaceae:

Celosia argentea Linn. Achyranthes aspera Linn. Alternanthera sessilis (L.) DC.

Polygonaceae:

Polygonum plebejum R. Br. P. glabrum Willd.
Euphorbia antiquorum Linn.
E. hirta Linn.
E. elegans Spreng.
Bridelia squamosa Gehrm,

Mallotus philippinensis (Lamk) Muell. Arg. Fleurya interrupta Gaud Boehmeria scabrella (Roxb.) Gaud.

Moraceae:

Ficus religiosa Linn.

Orchidaceae:

Habenaria rariflora A. Rich. Dendrobium microbulbum Rich. Eria dalzellii Lindl. Aerides crispum Lindl.

Hypoxydaceae:

Hypoxis aurea Lour

Dioscoreaceae:

Dioscorea pentaphylla Linn.

Commelinaceae:

Commelina bengalensis Linn.
C. obliqua Buch. Ham.
Murdannia spiratum (L.) Bruckn.
Cyanotis tuberosa (Roxb.) Schult. f.

Eriocaulaceae:

Eriocaulon sp.

Cyperaceae:

Cyperus brevifolius (Rottb.) Hassk.
C. triceps (Rottb.) Endl.
C. corymbosus Rottb.
C. flavesvcens Linn.
C. iria Linn.
C. metzii (Hochst.) Mattf. and Kuck
Fimbristylis tera R. and S.

Gramineae:

Cynodon dactylon (Linn.) Pers.
Echnochlea colenum (Linn.) Limk.
Garnotia stricta Brongn.
Paspalum compactum Roth.
Setaria glauca (Linn.) Beauv.
Bothriocloa pertusa (Linn.) A. Camus.
Digitaria stricta Roth ex R. and S.
Eleusine coracana (Linn.) Gaertn.
Sehima nervosum (Roth.) Stapf.

Ferns or Filicales:

Adiantum lunulathum Cheilanthes sp. Athyrium Sp. Asplenium Sp.

Bryophyta:

Riccia sp.
Fimbriaria Sp.
Targionia sp.
Cythodium sp.
Mosses about 10. species.

LIST OF IMPORTANT PLANTS COLLECTED AT SAPTASHRINGI HILLS by Cherian and Pataskar, 1969

Menispermaceae:

Cocculus hirsutus (Linn.) Diels. Tinospora cordifoliaa (Willd.) Miers.

Cruciferae:

Cardamine trichocarpa Hochst. Ex Rich.

Capparidaceae:

Capparis sepiaria Linn.

Cleomaceae:

Cleome viscosa Linn.

C. simplicifolia Hook, f. and Thoms.

Flacourtiaceae:

Flacourtia indica (Burn. f.) Merr.

Polygalaceae:

Polygala chinensis Linn.

Malvaceae:

Azanza lampas (Cav.) Alef. Hibiscus lobatus (Murr.) Ktze. Sida rhombifolia Linn.

Sterculiaceae:

Helicteris isora Linn.

Tiliaceae:

Corchorus trilocularis Linn. Grewia abutilifolia Linn. Triumfeta rhomboidea Jacq. T. rotundifolia Lam.

Linaceae:

Linum mysurense Heyne ex Benth.

Malphigiaceae:

Aspidopterys cordata (Hayne) A. Juss.

Balsaminaceae:

Impatiens balsamina Linn. I. kleinii wt. and Arn.

Burseraceae:

Boswella serrata Roxb. ex Coleber. Garuga pinnata Roxb.

Celastraceae:

Elaeodendron roxburghii Wt. and Ar.

Rhamnageae:

Zizyphus mauritiana Lamk.

Z. nummularia (Burm. f.) Wt. and Arn.

Z. rugosa Lamk.

Vitaceae:

Havratia carnosa (Lamk.) Gagnep.

Sapindaceae:

Cardiospermum halicacabum Linn.

Anacardiaceae:

Lannea corodmandelica (Houtt.) Morr,

Fabaceae:

Aeschynomene aspera Linn.

A. tetragonolobus Edgw.

Alysicarpus procumbens (Roxb.) Sc.

A. vaginalis (Linn.)

Butea monosperma (Lamk.) Taub.

Crotalaria mysorensis Roxb.

C. orixonsis Willd.

Dalbergia lancelaria Linn. f.

D. laxiflorum DC.

D. glandulosa Roxb. ex. Willd.

Rhynchosia minima DC.

R. rothii Benth. ex Ait.

Smithia bigemina Dalz.

Caesalpiniaceae:

Cassia absus Linn.

C. fistula Linn.

Mimosaceae:

Acacia intsia Willd.

Combretaceae:

Anogeissus latifolia Wall. ex. Bedd. Terminalia crenulata Roth.

Lythraceae:

Rotala densiflora (Roth) Koenhne.

Cucurbitaceae:

Diplocyclos palmatus (L.) Jeff. Dicoglospermum ritchiei Clarke.

Begoniaceae:

Begonia crenata Dryand.

Aplaceae:

Pimpinella heyneana Wall.

P. tomontosa Dalz, ex C. B. Clarke

Rubiaceae:

Borreria articularis (Linn. f.) F. N. Will.

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Mitragyna parvifolia (Roxb.) Korth.

M. maheshwarii Sant. and Mahesh.

Xeromorphis spinosa (Thumb.) Keay.

Asteraceae:

Acanthospermum hispidum DC.

Sclerocarnus africanus Jacq.

Senecio grahami Hook, f.

S. hewrensis Hook, f.

Campanulaceae:

Cephalostigma schimperi Hocht ex A. Rich.

Myrsinaceae:

Embelia tsjeriam cottam A. DC.

Sapotaceae:

Madhuca indica Gmel. Xantolis tomentosa (Roxb.) Raf.

Ebenaceae:

Diospyros melanoxylon Roxb.

Oleaceae:

Nyctanthes arbor-tristis Linn.

Apocynaceae:

Holarrhena antidysenterica (Linn.) Wall. Wrightia tinctoria R. Br.

Periplacaceae:

Cryptolepis buchnani Roem, and Sch. Pergularia daemia (Forsk.) Chiev. Tylophora dalzelli Hook, f.

Gentianaceae:

Enicostema verticillatum (Linn.) Engler. Exacum lawii C. B. Clarker.

Boraginaceae:

Cynoglossum meeboldii Brand.

Lentibulariaceae:

Utricularia lignosa Vahl.

Bignoniaceae:

Heterophragma quadriloculare (Roxb.) K. Sch.

Acanthaceae:

Nilgirianthus heyneanus Bremek, var. neesii Bremek.

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Thunbergiaceae:

Thunbergia laevis Ness.

Verbenaceae:

Clerodendrum serratum (Linn.) Monn. Tectona grandis Linn. f.

Lamiaceae:

Dysophylla stellata Benth. Lavendula bipinnata (Roxb.) O. Ktze.

Euphorbiaceae:

Acalypha malabarica Muell. Arg. Bridelia squamosa Garhm. Glochidion hoheneckeri Bedd. Mallotus philippinensis (Lamk.) Muell. Afg. Securinega virosa (Roxb.) ex willd. Pax and Hoffm,

Moraceae:

Ficus microcarpa Linn. F.

Urticaceae:

Fleurya interrupta (Linn.) Gaud. Lecanthus peduncularis (Wall.) Wedd. Pouzolzia zeylaniça Orchidaceae:

Aerides crispum Lindl. Habenaria digitata Lind. H. rariflora A. Rich.

Hypoxidaceae:

Curculigo orchioides Gaertn. Hypoxis aurea Lour

Zingiberaceae:

Curcuma pseudomontana Grah.

Dioscoreaceae:

Dioscorea bulbifera Linn.

Liliaceae:

Asparagus racemosus Willd. var javanicus Baker

5.5: Flora of Surgana—Harsul Ranges:

Surgana formerly a small State, is now a taluka in Nasik district. It lies close to Dangs in South Gujarat and to the northwest of Dindori. It lies at 20°.0'—20°.40' N and 73° 15-73° 45' East. The region is highly rugged. It has many deep ravines and narrow ridges and cross spurs, drained by several streams and rivers such as Par, Nar and Dawan. Soils are derived from the Deccan trap and are basaltic. The average altitude of the track is 600 m. The highest peak in Surgana is 884 m. The soils are (1) rich dark or black in valleys and ravines, (2) dark greyish green on slopes full of murum, and (3) reddish lateritic on hill tops and at higher elevations. They have matured under different conditions at different periods.

The average annual rainfall is 1900 mm between June and October. The maximum temperature in summer is 30-40°C and the minimum in winter is 10°C. The average mean temperature is not known. The flora of this place has been studied by Dr. P. J. Cherian and R. D. Pataskar (1969) who have published a paper on it in *Bull. Bot. Surv. India* 11 (2 and 3): 381—397. They collected 430 species of angiosperms belonging to 83 families, besides 5 species of pteridophytes—all ferns; and a few liverworts.

Vegetation.—The vegetation is mostly of dry deciduous type with some small grassy patches. In the ravines and valleys moist deciduous or semi-evergreen species are found e.g. Madhuca longifolia var latifolia, Mitragynas parviflora, Ficus arnottiana, Ficus nucricaroa, Schleichera trijuga (=S. oleosa), Terminalia bellerica. Due to high humidity there are many epiphytic orchids like Rhycostyliis retusa, Dendrobium species. Mosses occur on all trees. In small ponds Ceratopteris thallictorides, Limnophyton indicum, Ceratophyllum demersum occur in masses.

In some valleys really good semi-evergreen species are seen. They are Erinocarpus nimmonii, Cassia glauca, Schleichera oleosa, Dalbergia lanceolaria, Bauhinia malabarica, Terminalia chebula, Syzygium cumini, Stereospermum chelonoides, Tremma orientalis etc. Some valleys also contain some dry elements like Adina cordifolia, Tectona grandis, Terminalia crenulata, Terminalia chebula, Dalbergia latifolia, Lagerstrroemia parviflora, Gmelina arborea etc.

Lagerstroemia lanceolata, Macuranga peltata, Ficus virens Diospyros melanoxylon occur deep down in valleys as moist deciduous species.

The dry deciduous forests grown in several open valleys and slopes are dominated by *Tectona grandis*, *Dalbergia latilolia*, *T. chebula* and *T. crenulata* plant community, but can also grow in moist places.

A special noteworthy feature of the vegetation here is the mixture of dry and moist deciduous species both encircled by shrubs of Carissa congesta, Helicteris isora, Flacourtia indica, Clerodendron serratum, Vitex negundo, Acacia torta, Meyna taxifolia, Pavetta indica, Grewia abutilifolia at the edge of forests. The proportion of semi-evergreen species increases as we advance towards Dangs but it becomes less as we approach the plains. Finally they all merge into one another, Tectona grandis becoming conspicuous in Dangs and bamboos in Bansada in South Gujarat.

To get further picture of vegetation here, a list of selected plants noted by Cherian and Pataskar (1969) is given below.

On the top of mountain monsoon ephemeral flora occurs full of herbs like Cleone simplicifoliia C. chelidoni, Biophytum sensitivum, several legumes and small grassess Senecio grahami, Smithia setulosa, Smithia conserta, Impatiens balsamina, Cardamine trichopus, Habenaria digitata, Iphegenia indica occur in plenty.

On the slopes and shady mountain sides several important species of grass grow such as Sporobolus albidus, Panicum montanum, Themeda quadrivalvis, Trilobachnae species, Manisurus clarkei. They are especially noticeable near the villages Sawarna, Zhari, Boripada, etc.

ENUMERATION OF IMPORTANT SPECIES IN SURGANA—HARSUL RANGE

Ranunculaceae: Clematis hedysarifolia DC	Flowering Season N. A.
Dillenia ceae: Dillenia pentagyna Roxb	July
Menispermaceae: Cissampelos pareira Linn	September
Papaveraceae: Argemone mexicana Linn	July
Brassicaceae: Cardamine trichocarpa Hocch st es Rich	July
Flacourtiaceae: Flacourtia indica (Burm f.) Merr	July
Caryophyllaceae: Polycarpon prostratum (Forsk.) Aach. and Schwr.	July
Malvaceae: Azanza lampas (Cev.) Alef. Hibiscus furcatus Roxb. H. vitifolius Linn. Sida alba Linn. Thespesia populnea (L.) Soland ex. Corr.	July—September September September September September

Tiliaceae: Eriocarpus nimmonii Grah. Grewia glabra Bl. Triumfetta pillosa Roth	September September September
Linaceae: Linum mysorense Heyne ex Bentn.	. September
Malpighiaceae: Aspidopterys cordata A. Juss	. September
Balsaminaceae: Impatiens balsamina Linn I. kleinii Wt and Arn	September September
Rutaceae: Aegle marmelos Corr	September
Vitaceae: Ampelocissus latifolia (Roxb.) Planch Cissus pallida (Wall. ex. W. and A.) Planch	September September
Leeaceae: Leea edgeworthii Sant. L. macrophylla Roxb.	July-September July-September
Sapindaceae: Schleichera oleosa (Lour) Oken	
Fabaceae: Aeschynomene indica L	September
B. superba Roxb	September September September
Dalbergia lanceolaria Linn D. latifolia Roxb	July September
Desmodium diffusum DC	September
Dolichos falcatus Klein ex Willd	September September September
=Phaseolus khandalensi Sant	September September
Pongamia pinnata (L.) Pierre Rhynchosia rothii Benth ex Altch, Sesbania bispinosa (Tacq.) Wt	July—September September September
S. sesban (Linn.) Merr Teramnus labialis (Linn. f.) Spr Vigna vexillata (L.) Rich	September September September
Caesalpiniaceae:	•
Bauhinia lawii Benth B. malabarica Roxb	July

Cassia absus L. C. fistula L. C. obtusifolia L. Mimosaceae: Acacia pinnata Willd. A. polyantha Willd. A. sinuata (Leur.) Merr. A. torta (Roxb.) Craig	September September September July September July—September
Combretaceae: Anogeissus latifolia Beod. Calycopteris floribunda Lamk. Combretum ovalifolium Roxb. Terminalia bellerica Roxb. Terminalia chebula Retz. T. crenulata Roth	July—September July July—September July
Myrtaceae: Syzygium cumini (L.) Skeels	September
Lecythidaceae: Careya arborea Roxb	July
Lythraceae: Ammannia multiflora Roxb	September July—September September July
Cucurbitaceae: Bryonopsis laciniosa (L.) Naud Dicoelospermum ritohiei Clarke	September September
Apiaceae: Peucedanum grande Cl. Pimpinella heyneana Wall.	September September
Rubiaceae: Adina cordifolia (Roxb.) Hook. f Borreria articularis (L.) F. N. Wall	September September July July July July September July
Asteraceae: Blumea mollis (Don) Merr. Caesulia axillaris Roxb. Eclipta prostrata (Limm. F.) L. Emilia sonchifolia DC. Sclerocarpus africanus Jacq. Senecio grahami Hook. f. Tricholepis glaberrima DC	September July—September September September September September September
Lobelia ccae: Lobelia aslinoides Lamk	September
Plumbaginaceae: Plumbago zeylanica L A-127—46-A.	September

Primulaceae: Anagallis purmila SW.				september
Myrsinaceae: Embelia tojerium cottam I	OC,	••		July—September
Ebenaceae : Madhuca longifolia Mac var. latifolia (Roxb.) Chev	·· /• · ·		••.	July
Sapotaceae: Diospyros melanoxylon Ro	oxb.	• •		July
Oleaceae : Jasminum malabaricum W	t.			July
Apocynaceae: Carissa congesta Wt. Holarrhiena antidysenterica Wrightia tinctoria R. Br.	a A. D	C.	•••	September JulySeptember JulySeptember
Asclepiadaceae : Glianthus deceanensis Talb Tylophora dulzelli Hook, f		3.		September —October September
Gentianaceae : Canscora concanensi C. B. Swertia minor Knobl.	Cl.			September September
Boraginaceae: Adelocaryum caelestinum (Cordia dichotoma Forst. f. Heliotropium Indicum L.	7.7A Y Y	16.3		September
Convolvulaceae: Argyreia sericea Dalz. Ipomoea clarkei Hook. f.	स्थामेन स्थामेन	ाट) ज्याने	•••	September September September September September September September
Solanaceae: Nicandra physaloides (L.) (Solanum indicum L	Gaeth.	• •		September July—September
Scrophulariaceae : Buchnera hispida Buch, Ha Limnophila indica (L.) Dru Kubderbua cukuata (Colsm Lindernia nummularifolia (Torenia cordifolia Roxb.	ice. a.) Pent	1.		September September September September September
Bignoniaceae: Dolichandrone falcata Seen Oroxylum indicum (L.) Ver Stereospermum chelonoides	nt		 	July
Pedaliaceae : Sesamum mulayanum Nair		••		September
Thunbergiaceae: Thunbergia laevis Nees A-127—46-B.	exe	⊕ 7. ⊕	••	September

Acanthaceae: Barleria cristata L B. prattensis Sant. Carvia callosa (Wall.) Brem. Hemigraphis laterbrosa Nees Justicia betonica L Lepidagathis cuspidata Nees Neuracanthus sphaerostachyus Dalz. Rungia elegans Dalz. and Gibbs	September September July.—September September September September September September September September September—October
Verbenaceae Clerodendrum serrutum (L.) Moon. Gmelina arberea Roxb. Tectona grandis L. f. Vitex negunda L.	July—September July July July
Lamiaceae: Acrocephallus indicus (Burm.) Ktze Anisochilus carnosus Wall Leucus aspera Spreng L. lavandulaefolia Nees L. zeylanica R. Br Ocimun americanum L. Plectranthus mollis (Airt) Spr.	 September September September July—September September September September September
Amaranthaceae: Alternanthera sessilis (L.) R. Br Amaranthus spinosus L Celosia argentea L	July—September September September
Polygonaccae: Polygonum glabrum Willd P. plebejum R. Br	September September—October
Loranthaceae: Dendrophthoe fulcata (L. f.) Ctt. Viscum articulatum Burm,	September July—September
Emphorbiaceae: Bridelia retusa Spr	July July
Mallotuus philippinsis Muell. Arg. Manihot glaziovii Muell. Arg. Phyllanthus asperulatus Hutch. P. emblica L Securinega virosa Roxb. ex. Willd. pa	July—September July July September ax & July—September
Ulmaceae: Trema orientalis L. Bl Boehmeria scabrella (Roxb.) Gaud. Fleurya interrupta (L.) Gaud Pouzolzia zeylanica (L.) Benn	July—September September July—September
Moraceae: Artocarpus heterophyllus Lamk. Ficus arnottiana Mig. Ficus asperrima Roxb	July September

F. bengalensis L		July July July July July
Orchidaceae: Aerides crispum Lindl		July September July July July September September July
Zingiberaceae: Costus speciosus (Koenb) Sm Curcuma pseudomontana Greham	• • •	September July
Hypoxidaceae: Curculigo orchioides Gaertn Hypoxis aura Lour.		July July
Taccaceae: Tacca leontopetaloides T. pinnatifida Porst.		July—September
Dioscoreaceae: Dioscorea bulbifera L D. oppositifolia L D. pentaphylla L D. wallichii Hook f		July—September July—September September
Gloriosa superba L	•••	September July September July July July July
Commelinaceae: Commelina diffusa Burm. f. C. hasskarii C. B. Cl. C. kurzii C. B. Cl. C. peteata Hassk. C. suffruticosa B.l. C. notis cristata (L.) Don. C. fasciculata (Heyne ex Roth) Sch. f. Murdamnia nudiflora (L.) Brenan. M. semiteres (Dalz.) Sint.		September September September September September September September September September
n a this (not) all a	r	October July July September

Eriocaulaceae :				
Eriocaulon dianae Fyson	•••	• • •		September—October
E. margaretac Fyson	4.0	• • •		September
Cumaracaga				
Cyperaceae: Cyperus flavidus Retz				September
C. globosus All	• •	••	• •	September
C. iria L	· •			September
Courtoisia cyperoides Nees			• •	October
Eleocharis capitata R. Br.				September
Fimbristylis dichotoma (L.)				September
F. lawiana (Beeck.) Kern.				July
F. miliacea (L.) Vahl.				September
F. tenera R. and S				September
F. tetragona R. Br				September
Rhinchoipora wightiana Ste	ud.			September
Scirpus squarrosus L.				October
Scleria hebecarpa Necs				September
•				
Poaceae:				Cantanahan
Apluda mutica L.	4) C4	100000	• •	September
Arundinelua pumila (Joechs	st) Steu	10.		September
Bambusa adrundinacea Wil			£3.	
Brachiaria ramosa (L.) Sta	pi.	 £	189	Cantombon
Capillipedium huegelii (Ho	E130/6/8/547	apı,	8	September
Chloris virgata Sw.	 Davb		9-	September September
Coix gigantea Koem. ex. I		20,000	γ	September
Dendrocalamus strictus No		Stant	• •	July
Cichanthium annulalum (Fo		stept	• •	Cantamban
Echinochlea colonum (L.) I		tond	Sik.	September September
Eragrostis tenuifolia Hoch	v Stone	icaa.	2.9	
E. uniloides (Retz.) Nees e	B146217279090		20	September October
Eulalia trispicata Henr. Hackelochlos granularis (L	io k	1470	1	September-October September-October
Ingeline globose (Thumb)	7. K+2.	A SIJ	ŧ.,	September September
Isachne globosa (Thumb.) (Ischaemum indicum (Hout	O. Mar			
I. rugosum Salis	i.) Mici	ι.	• •	September
Manisuris clarkei (Hack.) I	Rorani	 ıd Sant	• •	September
Ophiureus exaltatus O. Kt	or api	ıa sanı.		September
Oplismenus burmanii (Retz			• •	September
O. compositus (L.) Beanv.			• •	September
P		· •	• •	JulySeptember
P. montanum Roxb	• •	• •		September-October
Paspalum compactum Rot		• •		September
Paspalum flavidum (Retz.)				September
Pseudanthistiria heteroclita	Hook	f f		September
Setaria glauca Beauv.	. 1100			July-September
S. verticillata Beauv.				September
Sorghum helepense Pers.		• •	.,	Sept-October
Spodiopogon rhizophorus (September-October
Themeda quadrivalvis (L.)	O. Ktz	ze.		September
T. triandra Forsk				September
Trilobachne cookei (Stapf.)) Schre	nc.		•
Tripogon jacquemontii Staj			• •	
	•			
Pteridophytes:				
Adiantum philippense L.				
Aleuritopteris albomargina	ta (Cl.,) Pan.	• •	

A. farinosa (Forsk.) Fee.
Athyrium fillioemina (L.) Roth.
Microsorium membranaceum (Don.) Ching.

On the whole, the flora of Nasik District seems to suffer from extremes of rains during monsoons and extreme dryness for the rest of the year. There is not much moisture in the air nor water in the soil. Soils are often completely eroded from the hill slopes. But in river basins of Godavari, Girna and Darna, post-climax vegetation occurs here and there. Good cash crops like sugarcane, onion, chillies and cotton grow on black alluvial soils in plains.

6. FLORA OF AHMEDNAGAR DISTRICT

Ahmednagar district is close to Nasik, Sholapur, Thane and Pune. It is at a higher altitude than Pune. Like Sholapur a part of it lies in famine zone. The southern parts of Ahmednagar get a little rainfall, and that too eratically. The talukas of Ahmednagar, Parner, Shrigonda, Shevgaon, Pathardi and a part of Rahuri lie in the dry belt. As such, there is always uncertainty of rains, often low. Due to this Ahmednagar district is dry. It gets hardly 20"-22" of rain and the number of rainy days is about 35-40. On the other hand, the north and the north-west region of Ahmednagar is better off, because of the proximity of Sahyadris and canal system fed by the Pravara river from a dam constructed at Bhandardara in Akola taluka. It supplies water continuously to Kopargaon, Shrirampur and a part of Rahuri. The forests are concentrated in Akola taluka which is at a higher altitude than Ahmednagar proper. A part of Parner, Rahuri, Pathardi, Shevgaon have small low hills. Close to Ahmednager also there are low hills which are a part of Baleshwar range. On a hill to the east there is a octangular tomb of Salabatkhan, popularly known as *Chandbibicha Mahal* which could be seen from 32 km. around. The hill is only about 200' high above ground.

The whole hill is very dry. There are no trees except tamarind and Mimusops hexandra or khirni. In Pathardi taluka also there are small hills on which small shrubs and grasses grow, the exception being a few trees of Semecarpus indicus. Shevgaon has deep black cotton soil which produces a good crop of jowar, provided there are sufficient rains. There are many tiny bushes of Zizyphus rugosa and Z. mauritiano Capparis aphylla. Barring these, there are no conspicuous trees in the area.

To the west of Ahmednagar on way to Aurangabad, there is a small ghat at Jeur. On the hillock there are many plants of *Phoenix sylvestris*. On the low lying areas *Mangifera indica*, *Flacourtia ramontchi*, *Leea microphylla* grow. To the north of Ahmednagar there is a small valley between two small hills of Baleshwar range at Dongargaon. It is known as "Happy Valley". A Shiva shrine and undergound water reservoirs make it very attractive. This hill also grows grass, as on the hill of Chandbibi Mahal, and looks green in rainy season, but dries up after the rainy season. This hill has only 4 or 5 kinds of trees.

The really significant vegetation of Ahmednagar district is in Akola taluka beyond Rajur. There is a ghat leading to Ghoti railway station on Bombay-Bhusawal route and forests along the crest line and in valleys. The overwhelming picture that emerges of vegetation of this district is of dry deciduous vegetation, scrub and open grasslands seen on so many low hills. This perhaps was not the case in the past, as could be seen

from the lists of fossil plants in Quaternary period given elsewhere in this book. However, the general picture is pockets of semievergreen or evergreen forests in certain places, especially in valleys in Akola having rich vegetation due to good rainfall, and serub and deciduous forests over the other places, and seasonal open grasslands on low hills.

Considered as whole, the flora of Ahmednagar district is mostly xerophytic thorn savannah or scrub, or open grassland in many places, except in Akola taluka in the valleys near the main range of Sahyadris. It is evergreen in Harishchandragad ravines. But a little away from it at Rajur, there are only dry deciduous forests having poor quality teak, but many other forest products.

There is similarity between the xerophytic plants and vegetation of the three dry districts—Ahmednagar, Sholapur and a part of Pune, notwithstanding the varied nature of soil. The other districts of Western India do not show so much of similarity as regards the plants, vegetation and rainfall. The lower portion of Nasik district towards east also has the same vegetation, and also in parts of Beed, Aurangabad and Jalna districts in Marathwada. The vegetation of Vidarbha region is better, though essentially it is similar in character, viz.,dry deciduous forests. Exception to this are the rich teak forests of Chandrapur.

The big rivers such as Godavari, Pravara, Mula and Sina drain the district south-eastwards.

Another peculiarity here is that there are some archaeological sites discovered on the banks of Pravara river at Jorwe, Newasa and further down on the banks of Godavari in Marathwada area having charred grains, seeds and dinosaurs. There are also Quaternary Leaf impression deposits on the banks of Pravara river at Sangamner and nearby areas.

The maximum rainfall recorded at Ahmednagar is 572.8 mm. The averge maximum temperature at Ahmednagar is 38.9°C and minimum is 11.7°C. July is the rainiest month and May the hottest. Humidity is generally low 20%, but in the rainy season it could be as high as 60-80%. The vegetation therefore, consists mostly of the dry deciduous type; the low hills have only scrub or open grass lands right from Ahmednagar to Madhi in Shevgaon taluka, and in Parner, Rahuri talukas. We shall, therefore, describe the plants and vegetation of four areas about which there is some information available: (1) Dongargaon or Happy Valley, (2) Sangamner, Chandanapuri Ghat and the areas of fossiliferrous Leaf Impression Beds, (3) Kotul and the living plants on the Travertine deposits, and (4) flora of Harishchandragad and vegetation of Dangi Hills. There are good pasture lands around Ahmednagar proper. They encourage lot of herdsmen to settle there during monsoons.

In Akola taluka there is sufficient vegetation. The high hill of Kalasubai is the highest point of Sahyadris (1646 m) in the Maharashtra State. Next to it not very far, is the Harishchandragad, the second highest point of Sahyadri in Maharashtra (1424 m.). At Rajur there is a forest of deciduous trees of *Tectona grandis*, *Terminalia chebula* and other deciduous species. Another place where there is some good vegetation is Kotul, a village in Akola. The river Mula rises from here, but falls immediately into a deep rocky valley beyond the waterfall at a place called Randha or Ranad. The annual rainfall at Kalasubai is nearly 250"-300"; at Kotul it is 150"; but at Rajur it is only 40"

The flora of Kotul has been worked out by Dr. D. R. Mahajan of Sangamner College. Barring these, the flora of no other place in Ahmednagar has been worked out.

The soils are basaltic and have poor capacity to hold water. The vegetation, therefore, is also poor. It is only at Harishchandragad that there is good forest in the valleys containing humid tropical evergreen species. The basalt is overlain by 2"-3" of soil, at places 10". The surface layer of soil, however, gets washed off or blown off by winds and cyclones in summer. We shall consider these separately.

6.1: Plants of Dongargaon or "Happy Valley":

About 20 km. north-west of Ahmednagar town, there is a small valley between two spurs of Sahyadris, easily approachable by road about 5 km. from Vambori Railway station on Daund-Manmad line at a place called Dongargaon. There are three underground water reserviors in the rocks, from which water trickles down all the time. Near them there is a Shiva temple. The place is barren, the soil being full of murum and pebbles. But with the advent of a few showers of monsoons, the place becomes green. Small Leguminous herbs and Compositae form a carpet. There are hardly 4-5 sparse tree species and 3-4 creepers. The rest are all herbs monsoon cphemerals (See list below). By about January the valley becomes brown and parched in May.

The flora of this place is xerophytic a dry scrub and a poor open grassland. It has not been worked out. Only Cooke (1901-1908) mentions some plants occurring here, mostly herbs which appear during rainy season. Wet rocks have some liverworts like Riccia discolor. On open ground there are some four-five remarkable plants-Monsonia senegalensis, Crotalaria mysorensis, Phyllanthus scabrifolius, Clematis triloba. The bushes of Gymnosporia montana and Malva parviflora occur scattered. A very remarkable feature of the flora here is the absence of any temperate plant, no doubt due to low elevation and rainfall, poor soil and the semi-arid environment. Seasonal grasses however appear to be regular feature. Monsonia senegalensis and Clematis triloba are remarkable plants of this place.

PLANTS OF DONGARGAON, DISTRICT AHMEDNAGAR (after Cooke)

Ranunculaceae:

Clematis triloba Heyne.

Anonaceae:

Anona squamosa L. A. reticulata L.

Malvaceae:

Malva parviflora L.

Geraniaceae:

Monsonia senegalenis G. and P.

Celastraceae:

Gymnosporia montana Benth.

Papillionaceae:

Crotalaria filipes Benth. C. mysorensis Roth Compositae:

Lagasca mollis Cav. Tridax procumbens L.

Convolvulaceae:

Ipomoea eriocarpa R. Br.

Scrophulariaceae:

Celsia coromandeliana Vahl. Linaria ramosissima Br.

Scrophulariaceae:

Moniera cuneifolia Michx.

Acanthaceae:

Justicia simplex Den.

Verbenaceae:

Vitex negundo L.

Labiatae:

Leucas biflorus R. Br.

Nyctaginaceae:

Boerhaavia repanda Willd.

Amaranthaceae:

Amaranthus polyganus L Pupalia lappaca Mog.

Santalaceae:

Santalum album L.

Euphorbiaceae:

Phyllanthus scabrifolius H. R. Acalypha indica L.

Açaiypna inaica L

Commelinaceae:
Commelina benghalensis L.

Graminaeae:

Panicum punctatum Burm. Ophiurus corymbosus Goert.

6.2: Flora of Sangamner and fossiliferous leaf beds:

Sangamner is taluka place in Ahmednagar district lying at 19°.34′ N and 74° 16′E at the confluence of rivers Pravara and Mahalungi. In the vicinity of it there are four fossiliferous localities of Leaf Impression Beds belonging to Quaternary period, and one on the Chandanapuri Ghat leading to Pune. The vegetation of the place is interesting, in as much as, it shows great contrast with that in the past as seen in Leaf Beds. The flora of Chandanapuri Ghat is much similar to that of the ghats near Shivaneri, being dry and full of xerophytic plants.

It lies in the rain shadow. The two long mountain spurs of Sahyadris from its main range are extended from Akola taluka. The highest peak of Sahyadri, Kalasubai, lies in one of them. Of the two ranges one runs on southern side and the other on northern side. In between the two lie the valleys of Mula and Pravara rivers. The highest point in the northern range is Dudheshwar 2748' high near the village Limbgaon Jali, 11 km north of Sangamner. The southern range is loftier, the

Baleshwar range. It rises to 3035' high at Hivargaon. The valleys of Mula and Pravara rivers between these two ranges are fairly well wooded with mango and babhul trees, Acacia arabica and A. leucophloca, especially towards west. The soil on the river banks is rich alluvium. The northern part is not so well wooded. There are a number of streams which run in the direction of the Godavari to the east.

The soil is derived from the trap and often mixed with gravel. The country to the west side is mostly bare; but where there is depression and good soil, it is wooded with *Tectona grandis*. Since the main Sahyadri range runs to the north-west of Akola, close to Sangamner, one expects that Sangamner will have good rains, but the statistics show that quite reverse is the case. The rains are uncertain, very often untimely. The mean monthly rainfall known for the last 45 years from 1931—1976 is as follows:—

(in millimetres)

January				5.69
February				0.19 to 0.26
March		~ F	à.,	1.5 to 1.60
April	150		ME.	6.3 to 6.5
May	/6			17.90 to 18.76
June	1			89.73
July		AND THE STATE OF T	46	92.01
August		YAUV	il D	56.71 to 58.80
September		J. R. J. J.	10/7	136.71 to 138.80
October	#	1.17	3.5	58.82 to 64.32
November	1			36.14
December		warming a		3.03
Average ar	nual	rainfall	끼식는	496.5

The region from Rajur to Sangamner lies in the rain shadow. Irrigation facility in Sangamner taluka is very limited. The soils are coarse and shallow; and, therefore, most of the vegetation around Sangamner is xerophytic. The fossiliferous leaf bed localities are: Modalwadi 22.4 km. north of Sangamner, Pimpalgaon Dhempa, Khadarmal and Khanderaowadi. They are also nearly at the same distance. The lists of living plants at these different localities are given separately. The living plants there now and those in fossils are not the same.

There are also archaeological sites at Jorwe near Sangamner and at Newase, from which the plants of archaeological period, especially the seeds have been discovered, and they are given in another Chapter. The list of plants today here shows that some plants such as Ficus arnottiana, Ceiba malabarica are similar to the ones that were present during late Pleistocene period, but not all. Salix tetrasperma, Ranunculus sceleratus found in fossils peat at Khanderaowadi are temperate plants, but in the vicinity of Sangamner there are no living temperate species except Salix tetrasperma. In the peat bed at Khanderaowadi we get also Podocarpus and Betula pollen grains. Both these plants are entirely lacking in the present flora of Sangamner, as well as in the whole of Maharashtra. They have certainly migrated from this area elsewhere. Most of the

living plants here grow on rocky soils or gravel, and they support only open grasslands and shrubs. The different beds of fossilised plants evolved as follows:—

- 1. Basal hard Traps: depth not known.
- 2. Intermediate Trap layers
- 3. Flora represented by pollen grains in fossil peat lens pockets found at Khanderaowadi: age approximately, 2300—2600 years.
 - 4. Flora of Leaf Beds around Sangamner: in fossiliferous localities Modalwadi etc.
- 5. Flora of archaeological sites Jorwe and Newase on the bank of Pravara river: age approximately 2000 years.
- 6. Modern Flora around Sangamner xerophytic scrub and open seasonal grasslands.

The flora in other similar places in Maharashtra might have passed through similar serial stages leading to dry deciduous vegetation.

6.3: Plants growing on leaf-bed localities:

The first Late Quaternary fossiliferous locality near Sangamner is Modalwadi.

It is 22.4 km. on Sangamner-Sakur road at 33.6 km. there is another locality called Pimpalgaon Dhempa. The plants found at these localities are given below:—

- I. Locality-Modalwadi near Pimpalgaon Dhempa.
- (1) Living Plants found -

Papaveraceae:

Argemone mexicana L.

Capparidaceae:

Cleome viscosa L. C. simplicifolia Hook.

Portulacaceae:

Portulaca oleracea L.

Malvaceae:

Sida veronicifolia Lamk. Abutilon indicum Sweet.

Vitaceae:

Leea macrophylla L.

Anacardiaceae:

Rhus mysorensis Heijne.

Papilionaceae:

Dalbergia melanoxylon Guill.

Mimosaceae:

Acacia arabica Willd.

Rubiaceae:

Morinda citrifolia L.

Acanthaceae:

Barleria cristata L.

Urticaceae:

Ficus bengalensis L.

(?) Plants found in the Valley at Modalwadi —

Filices:

Adiantum capillusveneris L. Actinopteris dichotoma Bedd. Pteris longifolia L.

Bombacaceae:

Salmalia malabaricum DC.

Zygophyllaceae:

Tribulus terrestris L.

Rutaceae:

Feronia elephantum Corren.

Meliaceae:

Azadirachta indica A. Juss.

Rhamnaceae:

Zizyphus jujuba Lamk.

Anacardiaceae:

Rhus mysurensis Heyne.

Caesalpiniaceae:

Cassia fistula L.

C. auriculata L.

Mimosaceae:

Acacia arabica Willd.

Combretaceae:

Combretum ovalifolium Roxb.

Lythraceae:

Woodfordia fruticosa Salisb.

Compositae:

Ageratum conyzoides L. Xanthium strumarium L. Tridax procumbens L.

Apocynaceae:

Carissa carandas L.

Asclepiadaceae:

Calotropis gigantea R. Br. Asclepias curasavica L.

Solanaceae:

Solanum nigrum L.

Acanthaceae:

Barleria cristata L.

Verbenaceae:

Lantana camara Moldenke Vitex negundo L.

Amaranthaceae:

Amaranthus spinous L. Achyranthus aspera L.

Polygonaceae:

Polygonum glabrum Willd.

Loranthaceae:

Viscum articulatum Burm.

Euphorbiaceae:

Euphorbia antiquorum L.

E. tirucalli L.

E. hirta L.

Bridelia retusa Spreng.

Urticaceae:

Ficus bengalensis L.

F. arnottiana Mig.

F. glomerata Roxb.

Salicaceae:

Salix tetrasperma Roxb.

Gramineae:

Setaria glauca Beauv.

The second locality from which fossil material is available is Khanderaowadi. Here the Leaf Bed lies along the river bank. It is over 3 km to the east from the village of the same name. The Leaf Bed is on a flat top near the hill from where apparently the streams were flowing in the past. The vegetation around this locality is of dry and mixed deciduous type. The plants found are given below. It is close to Chandanapuri Ghat. The terrain on which Leaf Bed occurs is undulating; the fossil plants are scattered on the hill top which is flat. Peat also was found deep down in the valley here.

II. Locality-Khanderaowadi

(i) The locality is undulating. The plants found on the flat top of the hills are —

Capparidaceae:

Cleome simplicifolia Hook. Gynandropsis gynandra DC. Capparis aphylla Roth.

Malvaceae:

Malva parviflora L.

Rutaceae:

Ruta graveolens Grah.

Meliaceae:

Melia azadirach L. Azadirachta indica Juss.

Rhamnaceae:

Zizyphus jujuba Lam.

Anacardiacaceae:

Rhus mysurensis Heyne. Odina woodier Roxb.

Papilionaceae:

Butea monosperma Koenig.

Caesalpiniaceae:

Caesalpinia bonducella Flem. Parkinsonia aculeata L. Cassia auriculata L.

Combretaceae:

Terminalia arjuna W. and A.

Lythraceae:

Ammannia floribunda Clarke. Woodfordia fruticosa Salisb.

Ebenaceae:

Diospyros embryopteris Pers.

Verbenaceae:

Vitex negundo L.

Graminae:

20 different kinds of grasses occur here.

(ii) Down the valley at Khanderaowadi the following plants are found:—

Filices:

Pteris longifolia L.

Malvaceae:

Abutilon indicum Sweet.

Rubiaceac:

Adina cordifolia Benth, and Hook.

Compositae:

Lagasca mollis Cav.

Plumbaginaceae:

Vogelia indica Gibs.

Apocynaceae:

Carissa congesta

Asclepiadeceae:

Hoya carnosa Br.

Solanaceae:

Solanum xanthocarpum Schd.

Pedaliaceae:

Martynia diandra Clox.

Acanthaceae:

Lepidagathis cristata Willd. Justicia diffusa Willd.

Verbenaceae:

Lantana camara L. Tectona grandis L.

Labiatae:

Leucas aspera Spr.

Euphorbiaceae:

Euphorbia antiquorum L.

Urticaceae:

Ficus arnottiana Mig. F. glomerata Roxb.

Commelinaceae:

Commelina bengalensis L.

Cyperaceae:

Cyperus rotundus L.

Graminae:

Setaria tomentosa Kunth. Eleusine indica Gaertn. Bambusa arundo Kalein.

The third locality is Nandur Khandarmal. This locality lies in a valley which is 28 km. from Sangamner on Sangamner-Pune Road. The locality is about 1.6 km to the east from Nandur Khandarmal village. The living plants found here are mentioned below. There is a valley by the side of the road in which also several plants are found. The vegetation is a mixture of xerophytic shrubs, herbs and deciduous trees.

III. Locality-Nandur Khandarmal

(i) Plants found on the top flat -

Ranunculaceae:

Clematis gouriana Roxb.

Papaveraceae:

Argemone mexicana L.

Portulacaceae:

Portulaca oleracea L.

Malvaceae:

Sida cordifolia L. Abutilon indicum Sweet.

Rutaceae:

Aegle marmelos Corr.

Vitaceae:

Leea macrophylla Roxb.

Anacardiaceae:

Mangifera indica L.

Papilionaceae:

Butea monosperma Koenig. Dalbergia latifolia Roxb. Pongamia glabra Vent.

Mimoseae:

Prosopis spicigera L.
Acacia suma Kurz.
A. arabica Willd.
Albizzia lebbek Benth.

Lvthaaceae:

Lagerstroemia parvifiora Roxb.

Apocynaceae:

Carissa carandas L.

—C. congesta

Verbenaceae:

Lantana camara L. Vitex negundo L.

Labiatae:

Pogostemon paniculatus Benth.

Amaranthaceae:

Celosia argentea L.

Urticaceae:

Ficus glomerata Roxb.

F. religiosa L.

Salicaceae:

Tamarix eriocoides Rottl.

Graminae:

Eleusine coranara Gaert. Cynodon dactylon Pers. and many other grasses.

(ii) In the valley by the side of the road going to Nandur Khandarmal the following plants grow:—

सत्यमव जयत

Filices:

Actinopteris dichotoma Forsk. Pteris longifolia L. Cheilanthes farinosa Kaulf.

Rutaceae:

Aegle marmelos Corr.

Meliaceae:

Azadirachta indica Juss.

Rhamnaceae:

Zizyphus jujuba Lamk.

Anacardiaceae:

Rhus mysurensis Heyne.

Papilionaceae:

Butea monosperma Koenig.

Caesalpiniaceae:

Caesalpinia bonducella Flem. Cassia auriculata L.

Mimoceae:

Acacia arabica Willd. Albizzia lebbek Benth.

Compositae:

Lagasca mollis Cav. Artemessia vulgaris Clarke. Echinops echinatus Roxb. Parthenium histerophorus L. Apocynaceae:
Nerium indicum Mill.

Verbenaceae:

Tectona grandis L.

Urticaceae:

Ficus religiosa L. F. glomerata Roxb.

Palmae:

Phoenix sylvestris Roxb.

All these lists when compared with those of fossil plants which are elsewhere given will show that ancient plants here were different from those living at present and the vegetation seems to have changed through successive periods to the dry deciduous one at present from moist cold deciduous stage.

6.4: Flora of Chandanapuri Ghat:

Chardanapuri is a village at the foot of the ghat of the same name on Sangamner-Pune road, about 15 km. from Sangamner. It is a dry place. The ghat section is about 3 km. Much of its flora is in its lower region. The upper portion has very few shrubs or bushes, mostly pteridophytes. Some of the plants listed below do not occur on the top region towards Narayangaon, or in other dry ghats. There is only a scrub or thorn savannah formed by bushes of Gymnosporia montana, Euphorbia antiquorum and Vogelia indica which is a rare plant of Plumbaginaceae and Rhus mysorensis Withania sommifera also occurs but generally in lower region where soil has some moisture. It grows to a height of an undershrub and has much large leaves; possibly it is a distinct cytoecotype. The plant is highly medicinal and deserves to be studied for its alkaloid content and autoecology. Diospyros embryopteris and Tamarix dioica occur in the lower reaches, but are not common. Carissa congesta, Asparagus racemosus occur here, as in Shivaneri Ghat and dry hills like Vetal near Pune and on other hills in Maharashtra. Ficus arnottiana occurs in rocky ledges but is not at all common. The rainfall in this region being low and rocks being hard, trees are stunted. But possibly it was not so in the distant past as this species is generally found in the ghats with high rainfall. It is also found in the fossil leaf beds here.

The plants found here are given below :-

Ranunculaceae:

Ranunculus scleratus L.

Anonaceae:

Anona squamosa L.

Capparidaceae:

Capparis aphylla Roth.

Tamaricaceae:

Tamarix dioica Roxb.

Rhamnaceae:

Zizyphus rugosa Lam.

Vitaceae:

Leea macrophylla Roxb.

A-127-47-A-

Anacardiaceae:

Mangifera indica L. Rhus mysurensis Heyne. Odina woodier Roxb.

Papilionaceae:

Pongamia glabra Vent.

Mimoceae:

Prosopis spicignera L. Acacia arabica Willd.

Combretaceae:

Combretum ovalifolium Roxb.

Myrtaceae:

Psidium guava L.

Lythraceae:

Woodfordia fruticosa Salisb.

Plumbaginaceae:

Vogelia indica Gibs.

Apocynaceae:

Carissa congesta Wight.

Asclepiadaceae:

Calotropis gigantea Br.

Solanaceae:

Solanum xanthocarpum Schi. Withania somniferum Dun. Datura stramonium L.

Verbenaceae:

Lantana camara L.

Euphorbiaceae:

Euphorbia nerifolia.

E. antiquorum L.

E. tirucalli L.

Phyllanthus emblica L.

Putranjiva roxburghii Wall.

Ricinus communis L.

Urticaceae:

Ficus religiosa L.

F. glomerata Roxb.

F. arnotiana Mig.

F. bengalensis L.

Salicaceae:

Salix tetrasperma Roxb.

Musaceae:

Musa superba Roxb.

Amaryllidaceae:

Agave americana L.

Liliaceae:

Asparagus racemosus Willd. var. javanica Baker.

Scilla indica Roxb.

Aloe vera L.

A-127-47-B.

Palmae:

Phoenix sylvestris Roxb.

Graminae:

Pennisetum typhoideum Rich. Setaria plicata Cooke.

S. glauca Beauv.

Dendrocalamus strictus Nees.

(ii) There is a waterfall here running from top to narrow valley down, about 125 feet. The plants found near the waterfall are—

Filices:

Actinopteris dichotoma Forsk. Adiantum capillus veneris L. A. lunulatum Burm. Pteris longifolia Bedd.

Umbelliserae:

Centella asiatica L.

Hydrocharitaceae:

Hydrilla verticillata Presl Vallisneria spiralis L. Ottelia alsinoides Pers.

Pontederiaceae:

Eichornia crassipes Solsm.

Pandanaceae:

Pandanus tectorius L.

Araceae:

Pistia stratiotes L. Pothos scandens L.

Naiadaceae:

Potamogeton indicum Roxb.

6.5: Flora of Kotul and Kotuleshwar Temple area:

Kotul in Akola taluka is about 41.6 km from Sangamner and lies on high rocky plateau from where the river Mula rises going towards Mulanagar and Rahuri. The place is full of rocks containing numerous quartz veins, Chalcedony, agates, colourful quartz crystals or colourless ones in the veins. There is plenty of lime, and lime dust in the neighbourhood and it gets spread all over, and accumulates in the area along the streams and cascades. The rainfall is 40" or more and there is forest all around in the valley. The streams, and acidified water from surrounding debris dissolve thick lime dust and also calcite (plentiful here), and gives rise to travertine deposits along Mula river. They are in the form of caves. Calceolus plants grow on them, river bank and around the Kotuleshwar temple. There are 2-3 large travertine caves near the temple. There is forest along the banks of Mula; but the most interesting plants are found on travertine tops and some lie embedded in the travertine tufa near a place called Sahasradhara. The situation here is somewhat similar to the Sahasradhara stream near Dehradun in Uttar Pradesh. There are many tiny concretions on the roof of a cave. They owe their origin to highly calcarious waters trikling down from the roof of a cave. These deposits are full of calcium, more than 90% and the rest 10% dust and earth. The tufa which forms the travertine is derived from the calcite rich area around.

Travertine deposits here contain 14 fossil diadoms, about 6 members of Myxopyhceae, and a calceolus Pottiaceous moss, *Anectangium stachyanum* Mitt. G. (Mahajan, 1978) in Ph. D. Thesis. These are described in the Chapter on fossil plants of Maharashtra.

There is a valley below the Kotuleshwar temple, through which the river Mula flows. On the plateau at top there are a number of herbs and ephemerals. In the valley Tectona grandis, Anogeissus latifolia, Terminalia chebula, T. bellerica, T. crenulata, T. tomentosa grow. The growth of Tectona grandis, however, is not prolific. The forest here, therefore, is not known for good teak as for other forest products such as gum arabic, myrobalans from T. chebula, gum resin from Boswellia serrata, Bidi leaves of Tendu or Dospyros embryopteris, Katha or Kutch from Acacia catechu, fruits of Amla or Phyllanthus emblica. Rosha grass, medicinal plants like Mentha viridis grow plentiful along streams and also some fragrant Compositae and Labiateae. In crevices of rocks Musa superba grows in number of places. These plant products are obtained in large quantities.

There are many secondary species in forests here like Butea monosperma, Bridelia retusa, Mundulea suberosa on dry slopes. In moist areas on rocks Hydrocotyle asiatica and other water loving herbs. Cyperi and grasses grow abundantly; on calcareous soils, on rocks Ficus glomerata, Ficus arnottiana, some ferns are noticed. Due to such plants the vegetation here looks more green than at many other places. The lists of plants around Kotul and Kotuleshwar temple and along the Mula river bed are as below:—

I. Pteridophytes:

Selaginella reticulata.
Adiantum capillus-veneris.
A. caudatum L.
A. lunulatum Burm.
Pteris longifolia Bedd.

Cheilanthes farinosa Kaulf.

C. rufa Don.

Flowering plants

Compositae:

Caesulia axillaris Roxb.

Acanthaceae:

Justicia diffusa Willd.

J. coromandeliana var. malabarica Willd.

II. The plants found on top of the Travertine dome:

Papaveraceae :

Argemone mexicana L.

Lythraceae:

Woodfordia fruticosa Salisb.

Compositae:

Ageratum conyzoides L. Xanthium strumarium L. Tridax procumbens L. Sonchus arvensis L.

Verbenaceae:

Lantana camara var. aculeata Moldenke. L. indica Roxb. Duranta plumeri Jacq. Vitex negundo L.

Labiatae:

Ocimum americana L. Pogostemon heyneanus Benth.

III. Kotuleshwar temple area:

Anonaceae:

Anona reticulata L. A. squanosa L.

Meliaceae:

Azadirachta indica A. Juss.

Caesalpiniaceae:

Tamarindus indica L,

Mimoseae:

Acacia arabica Willd.

Apocynaceae:

Plumeria acutifolia Por. P. rubra L.

Vinca rosea L.

Scrophulariaceae: Striga alba Benth.

Urticaceae:

Ficus glomerata Roxb.

Ameryllidaceae:

Pancratium asiaticum L. Artabotrys odoratissimus Br.

IV. Plants found along the river banks of Mula:

Compositae:

Ageratum conyzoides L.

Amaryllidaceae:

Agave americana L.

Araceae :

Amorphophallus commutatus Engler. Colocasia antiquorum Schott.

Cyperaceae:

Cyperus rotundus L.

Menispermaceae:

Tinospora cordifolia Miers...

Capparidaceae:

Capparis aphylla Roth.

Malvaceae:

Sida veronic ifolia Lamk. Abutilon ind icum Sweet.

Rhamnaceae:

Zizyphus jujuba Lamk.

Mimoseae:

Acacia arabica Willd.

Asclepiadaceae:

Asclepias curasavica L.

Compositae:

Caesulia axillaris Roxb.

Polygonaceae:

Polygonum glabrum Willd.

Euphorbiaceae:

Euphorbia spelendens Boj. E. antiquorum L.

Pandanaceae:

Pandanus odoratissimus L.

Cyperaceae:

Cyperus rotandus L.

V. Plants found in the bed of river Mula:

Nymphaeaceae:

Nymphaea pubescens Willd.

Hvdrocharitaceae:

Ottelia alismoides Pers. Vallisneria spiralis L. Hydrilla verticillata Pers.

Zingiberaceae:

Hedychium coronarium Koening.

Pontederiaceae:

Eichornia crassipes Solms.

Lemnaceae:

Lemna polyrhiza L.

Naiadaceae:

Potamogeton crispus L.

None of these plants occur in tufa or on travertine tops or in it.

6.6: Flora of Harishchandragad:

The three places rich in vegetation, Harishchandragad, Kalasubai and Kotul, are in Akola taluka. The vegetation of Rajur is typically dry deciduous, but that of Harishchandragad is unique in as much as it has some remnants of evergreen and semi-evergreen species, in pockets of vegetation in ravines on the sunny side. The other side is a steep rock wall facing full blast of SW monsoons. The flat platforms on the crests have thorny bushes forming scrub, and numerous monsoon ephemerals, grasses and legumes. They also contain a few temperate species.

Harishchandragad area lies at the intersection of four districts, Thane, Pune, Ahmednagar and Nasik. It is almost inaccessible during rains and has numerous reptiles. There is a dilapidated fort on the top and a Kedarnath temple. The mount is formed by 10-12 consolidated lava flows and there are some caves and underground water reservoirs in the intertraps as on Sinhagad or in Mahabaleshwar Ghat. There are flat platforms on 2-3 high peaks. There is a ghat on Peint side known as Sadrya ghat and one on Akola side going to Ghoti railway station on the Central Railway. On the top of the fort there is, a balekilla, known as Taramaticha Dongar. South-west side of the fort is fully exposed to rains and winds. It gets about 200-250" of rainfall. Maximum rainfall is in July-August. After the rains the place dries up and looks brown and barren in April-May. The daily temperatures are the lowest in the month of January and the highest in the month of May.

Vegetations.—The vegetation of this place was not studied earlier, nor any botanists have visited this place except perhaps Dalzell. It was studied only recently by K. V. Billore and K. Hemadri (1969) and by V. D. Vartak (1971). Billore and Hemadri collected plants from April to November. They collected 330 species of flowering plants spread over 245 genera and 87 families (see list given below).

Harishchandragad can be approached from Marbad in Thane district, from Akola in Ahmednagar district or from Peint in Nasik district for studying the vegetation. The vegetation of Sadrya ghat consists of some deciduous and some semi-evergreen species such as Terminalia crenulata, Wrightia tinctoria, Lagerstroemia parviflora, Madhuca longifolia, Bombax ceiba, Adina cordifolia, Xeromorphis spinosa, Schrebera oleosa, bushes of Carissa congesta and shrubs of Eranthemum purpuresens. They are mixed with species of Blumea, Echolium viridis, Anisomelis boumontsia and Centratherum phyllolaeanum.

Other important trees here are Ixora brachiata, Carallia brachiata, Bridelia squamosa, not forming a community, but growing here and there. In ravines and on shady slopes at higher level, Sterculia guttata, Heterophragma quadriloculare, Grewia tilaefolia, Atlantia racemosa, Putranjiva roxbourghii, Albizzia amara are common. The ecological range of the last named species viz., Albizzida amara is rather interesting and has been studied by Meher-Homji of French Institute, Pondichery. A very remarkable feature of the vegetation here is the absence of Tectona grandis which is a typical tree of deciduous forests. Only 16-19 km. away from this place at Rajur to the east, it is abundant. Apparently it does not seem to tolerate heavy rains and needs some resting dry period like winter and summer.

Many climbers especially Ventilago bombaiensis are found at the foot of the hill, in ghat and on open slopes. Side by side with them Anisomeles heyneana bushes and Vicoa cernua, Blumea belangeriana grow in plenty and form undergrowth.

At the foot of Pachnai plateau on way to the Gad there are scattered strands or patches of Memecylon umbellatum, Terminallia chebula, Canthium dicocum, Mallotus philippinensis, Xantholis tomentosa, Heterophragma quadrangulare, Lagerstroemia lanceolaris, Cassia fistula. Shrubs of Pavetta concanica, Gymnosporia rothiana, Carissa congesta, Leea indica, Lobelia nicotianaefolia etc. grow on the outskirts of forests.

On the lower hill slopes of Kedarnath and on slopes of Taramaticha Dongar, there are typical semi-evergreen plants viz., Memecylon umbellatum, Ligustrum perotteti, Olea dioeca, Actinodaphne angustifolia, Glochidion hohenackeri, Syzygium cumini, Litsea zeylanica, Atlantia racemosa, Symplocos beddomei. They are more concentrated in the valley at lower level than here on the plateaux below the top. There is plenty of undergrowth formed by Thelepaepale exocephala. A few shrubs of Osyris wightiana, Gymnosporia rothiana, Elaeagnus conferta, Acacia torta, Jasminum malabaricum are very common.

The rainfall here, more so in valleys, being very heavy, the trees are covered with mosses densely and by orchids like Aerides crispum, Dendrobium herbaceum and by Viscum articulatum.

On the open tableland around Kedarnath temple and Taramaticha Dongar, there are many herbaceous plants and some isolated clumps of Euphorbia neriifolia, Ligustrum perotteti, Tricholepis amplexicaulis, Vernonia divergens, Clematis wightiana (rather rare), Rubia cordifolia. Species of ground orchid Habenaria, Nilgirianthus reticulatusand strands of big grass Heteropogon triticaceous are met with.

The herbaceous flora on top platforms consists of monsoon ephemerals, Alysicarpus belagaumensis, Smithia stocksii. In moist and waterlogged situations Hygrophila serpyllum Dysophylla stellata, Habenaria gibsonii. Eriocaulon indica are found.

On wet rocks lithophytes and two species of the rare family Podoste-maceae. *Termiola zeylanica* and *Dicrea dichotoma*, are found. They are rather interesting plants of running streams, but get dried up as soon as the streams cease to have water.

Thus the flora is a curious mixture of relict tropical evergreen types in ravines or semi-evergreen ones in valleys, herbaceous monsoon ephemerals on top platforms, bushes and drier species on the lower slopes and in Sadrya ghat. They slowly merge into deciduous species towards Rajur, but having moist species towards Peint and having practically no vegetation except grasses towards Konkankada scarp. As Harish-chandraggad is adjacent to Peint (Nasik) and Thane forests, it shows considerable resemblance with both of them. Its vegetation in drier areas is similar to that of Junnar ghats and that on top of Shivaneri fort. It becomes progressively made up of drier species as one proceeds towards Chandanapuri Ghat in Sangamner taluka. But the vegetation at higher slopes and on top flats reminds one of the species seen on the Matheran plateau except the evergreen members like Garcinia species which are not here.

Harishchandragad is surrounded by other hills and hill forts like Aundha-Patta fort Ratangad etc. The flora of these hills and forts and the hill peaks has been studied by V. D. Vartak (1970) which is considered next.

List of Plants of Harishchandragad (after Billore and Hemadri 1969)

Ranunculaceae:

Clematis hedysarifolia DC. C. wightiana Wall. ex Wt. and Arn. Thalictrum dalzellii Hk.

Anonaceae:

Miliusa tomentosa (Roxb.) Sinclair.

Menispermeaceae:

Cyclea peltata (Lamk.) N.K.f. and Thoms. Stephania japonica (Thunh.) Miers.

Papaveraceae:

Argemone mexicana Linn.

Cleomaceae:

Cleome gynandra Linn.

Capparidaceae:

Capparis rotundifolia Rottl. C. spinosa Linn.

Flacourtiaceae:

Flacourtia indica (Brum f.) Merr.

Caryophyllaceae:

Polycarpon prostratum (Forsk.) Asch. and Schw.

Portulacaceae:

Portulaca oleracea Linn.

Malvaceae:

Abelmoschus manihot (Linn.) Medic. SSp. tetraphyllus (Roxb. Ex. Hernem.) Borss. var. megaspermus Hemadri var. nov. Aubtilon sersicus (Burm. f.) Merr.

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Hibiscus hirsutus Linn. (N. albotii Rakshit).

Sida cordata (Burm. f.) Pors.

S. mysurensis Wt, and Arn.

S. rhombifolia Linn.

Bombacaceae:

Bombax ceiba Linn.

Sterculiaceae:

Streculia guttata Roxb.

Tiliaceae:

Grewia tiliaefolia Vahl. var. leptopetala (Brandis) Cooke.

Triumfetta annua Linn.

T. rhomboide a Jacq.

Linaceae:

Linum mysrense Heyne ex Benth. apud. Lindl.

Balsaminaceae:

Impatiens balsamina Linn. var. rosea Linel.

Impatiens pusilla Heyne

Rutaceae:

Atlantia racemosa Wt. and Arn. Murraya koenigii (Linn.) Spreng. M. paniculata (Linn.) Jack. Amoora lawii (Wt.) Bedd.

Celastraceae:

Celastrus paniculatus Willd.

Gymnosporia rothiana (Wt. and Arn.) Laws.

Rhamnaceae:

Ventilago bombaiensis Dalz. Zizyphus rugosa Lamk.

Leeaceae:

Lee a indica (Burm. f.) Merr. L. robusta Roxb.

Vitaceae:

Cayratia elongata (Roxb.) Suess. C. repanda Vahl.

Sapindaceae:

Schleichera oleosa (Lour.) Oken.

Anacardiaceae:

Mangifera indica Linn.

Fabaceae:

Alysicarpus belgaumensis Wt. Atylosia line ata Wt. and Arn. Crotalaria filipes Bentn. C. leptostachya Benth. C. retusa Linn. C. trique tra Datz. Cvlista scariosa Roxb. Desmodium rotundifolium Baker. Erythrina stricta Roxb. Indigofera trita Linn. Moghania strobilifera (Linn.) st. Hil. ex Jecks. Nogra simplicifolia (Dalz) Raizada Phase olus sublobatus Roxb. Smithia bigemina Dalz. S. hirsuta Dalz. S. purpurea Hook. S. setulosa Dalz. Teramnus labialis (Linn. f.) Spreng.

Caesalpiniaceae:

Bauhinia racemosa Lamk. Cassia fistula Linn.

Vigna vexillata Linn.

Mimosaceae:

Acacia torta (Roxb.) Craib. Albizzia odoratissima (Linn. f.) Benth.

Crassulaceae:

Kalanchoe pinnata (Lamk.) Pers.

Combretaceae:

Terminalia bellerica (Breyn ex Gaartn.) Roxb. Terminalia chebula Retz.
T. crenulata Rath.

Rhizophoraceae:

Carallia brachiata (Lour.) Merr.

Myrtaceae:

Syzygium cumini (Linn.) Skeels.

Melastomaceae:

Memecylon umbellatum Burm. f.

Lythraceae:

Ammannia haccifera Linn.

Lagerstroemia microcarpa Wt. (L. lance olata Wall ex Wt. and Arn.)

L. parviflora Roxb.

Rotala densiflora (Roxb.) Koehne.

R. serpyllifolia (Roxh.) Bremek.

Woodfordia fruticosa (Linn.) Kurz.

Samydaceae:

Case aria grave olens Dalz.

Cucurbitaceae:

Discospermum ritchici Cl.

Molluginaceae:

Glinus lotoides (Linn.) Loefl.

Apiaceae:

Heracleum pinda Dalz.

Peucedanum grande Cl.

Pimpinella adscendens Dalz.

P. heyneana Wall.

P. monoica Dalz.

Trachyspermum stictocarpum (Cl.) Wolff.

Rubiaceae:

Adina cordifolia Hook. f. ex. Brandis.

Canthium dicoccum var. umbellatum (Gamble) Sant.

Dentillana corymbosa (Willd.) Kuntze.

Ixora brachiata Roxb.

Mitragyna parvifolia (Roxb.) Korth

Anotis calycina (Wall. ex Hook. f.) Lewis.

A. lancifolia (Hook, f.) Lewis

Oldenlandia corymbosa Linn.

O. maheshwarii Sant, and Merch.

Pavetta concana Bremek.

Rubia cordifolia Linn.

Spermadictyon suaveolens Roxb.

Wendlandia heynei (R. and S.) Sant and Merch.

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Xeromphis spinosa (Tkunb.) Keay.

Asteraceae:

Ageratum conyzoides Linn.

Bidens biternata (Lour.) Merr. et Scherff.

Blumea belongeriana DC.

B. eriantha DC.

B. malçolmii (Cl.) Hook. f.

B. membranacea DC.

B. oxyodonta DC.

B. salidaginoides (Poir.) DC.

Caesulia axillaris Roxb.

Centratherum phyllolaenum (DC.) Benth. Ex. Cl.

C. tenue (Wt.) Cl.

Conyza leucantha (D. Don) Ludlow and Raven.

C. stricta Willd.

Cyathocline lutea Law. ex Wight.

C. purpurea (Don.) Ktge.

Eclipta prostrata (Linn.) Linn.

Emilia sonchifolia (Linn.) DC.

Gnaphalium indicum Linn.

Gynura cusimbusa (D. Don) S. Morre.

Lamprachaenium microcephalum (Dalz.) Benth.

Senecio dalzellii Cl.

S. grahami Hook. f.

Sphaeranthus indicus Linn.

Tricholepis amplexicaulis Cl.

Vernonia divergens (Roxb.) Edgw.

Vicoa cernua Dalz.

Lobeliaceae:

Lobelia alsinoides Lamk.

L. nicotianaefolia Heyne.

Campanulaceae:

Wahlenbergia marginata (Thunb.) A. DC.

Primulaceae:

Anagallis pumila Swartz

Myrsinaceae:

Embelia tsjeriam cattam A. DC.

Sapotaceae:

Madhuca longifolia (Koen.) mac Bride var. latifolia (Roxb.)

Chev

Xantolis tomentosa (Roxb.) Raf.

Symplocaceae:

Symplocos beddomei C1.

Oleaceae:

Jasminum malabaricum Wt.

Ligustrum perrottetii A. DC.

Olea dioica Roxb.

Schrebera swietenioides Roxb.

Apocynaceae:

Carissa congesta Wt.

Wrightia tinctoria R. Br.

Asclepiadaceae:

Cyanchum callialata Hem.

Gymnena sylvestris (Retz.) R. Br. ex Schult.

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Tylophora dalzellii Hook. f.

Periplocaceae:

Hemidesmus indicus Schultes

Gentianaceae:

Canscora difusa (Vahl.) R. Br. ex R. and S.

Centaurium centaurioides (Roxb.) Rolla Rao et.

Swertia corymbosa var. lawii C. B. Cl.

S. minor (Griseb.) Knobl.

Boraginaceae:

Adelocaryum coelestinum (Lindl.) Brand.

Cordia dichotoma Forest. f.

Paracaryum malabaricum C. B. Cl.

Convolvulaceae:

Argyreia strigosa (Roth.) Sant. et Patel.

Porana racemosa Grah.

Cuscutaceae:

Cuscuta reflexa Roxb.

Solanaceae:

Solanum nigrum Linn.

S. indicum Linn.

Scrophulariaceae:

Buchnera hispida Buch-Ham,

Lindernia parviflora (Roxb.) Haines

Rhamphicarpa longiflora (Arn.) Benth.

Sopubia delphinifolia (Roxb.) G. Don.

Striga asiatica (Linn.) Kuntze var. asiatica.

S. gesnerioides (Willd.) Vatke.

Rungia pectinata (Linn.) Nees.

Thelepaepale ixiocephala (Benth.) Bremek.

Verbenaceae:

Callicarpa tomentosa (Linn.) Murray.

Vitex negundo Linn.

Lamiaceae:

Anisomeles heyneana Benth.

Colebrookea oppositifolia Smith.

Dysophylla stellata Benth.

Leucas ciliata Wall. ex Benth.

L. lavandulaefolia Rees.

L. stelligera Wall. ex Benth.

Nepeta hindustana (Heyne ex Roth) Haines var. woodrowii Sant.

Plectranthus mollis (Ait.) Spreng.

P. stocksii Hook. f.

Pogostemon plectranthoides Desf.

P. purpurascens Dalz.

Salvia plebeia R. Br.

Amaranthaceae:

Achyranthus aspera Linn. var. porphyristachya Hook. f.

Aerrua sanguinolenta (Linn.) Bl.

Alternanthera sessilis (Linn.) DC.

Amaranthus hybridus Linn. SSp. cruentus Thell. var. paniculatus Thell.

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A. lividus Linn. SSp. polygonoides (Moq.) Probst.

A. spinosus Linn.

Celosia argentea Linn.

Chenopodiaceae:

Chenopodium album Linn.

C. murale Linn.

Polygonaceae:

Polygonum chinense Linn.

P. glabrum Willd.

P. plebejum R. Br.

Podostemaceae:

Dicraea dichotoma (Gardn.) Tul.

Terniola zeylanica Tul. var. konkanica (Willis) Sant.

Piperaceae:

Piper trichostachyon (Mig.) C. DC.

Lauraceae:

Actinodaphne angustifolia Nees.

Listea zeylanica Nees.

Thymelaeaceae:

Lasiosiphon eriocephalus (Gr.) Decne.

Elaeagnaceae:

Elaeagnus conferta Roxb.

Loranthaceae:

Dendrophthoe falcata Etting var. coccinea Talb. Macrosolen capitellatus (Wt. and Arn.) Danser.

Viscum angulatus Heyne ex DC.

Santalaceae:

Osyris wightiana Wall. ex Wight.

Euphorbaceae:

Bridelia squamosa Gehrm.

Embelia officinalis Gaertn.

Euphorbia torta Linn.

E. nerifolia Linn.

E. pycnostegia Boiss.

Glochidion hohenackeri Bedd.

Macaranga peltata (Roxb.) Muell. Arg.

Mallotus philippinensis (Lamk.) Muell. Arg.

Phyllanthus simplex Retz.

Putranjiva roxburghii Wall.

Ricinus communis Linn.

Sapium insigne Benth. var. malabaricum (Wt.) Hook, f.

Securinega virosa (Roxb. ex. Willd.) Baill.

Tragea mulleriana Pax et. Hoffm. var. unicolor Pax and Hoffm.

Trewia polycarpa Benth.

Ulmaceae:

Celtis cinnamomea Lindl.

Trema orientalis (Linn.) Bl.

Urticaceae:

Boehmeria scabrelia (Roxb.) Gand.

Girardinia zevlanica Decne.

Moraceae:

Ficus arnottiana Mig.

F. asperrima Roxb.

F. racemosa Linn.

F. glomerata L.

Salicaceae:

Salix tetrasperma Roxb.

Burmanniaceae:

Burmannia pusilla (Wall. ex Miers) Thw.

Orchidaceae:

Aerides crispum Lindl.

A. maculosum Lindl.

Dendrobium aqueum Lindl.

D. herbaceum Lindl.

Habenaria gibsoni Hook. f.

Peristylis densus (Lindl.) Sant. et Kapad.

Zingiberaceae:

Curcuma pseudomontana Gr.

Hypoxidaceae:

Curculigo orchioides Gaertn.

Agavaceae:

Agave sp.

Dioscoreaceae:

Dioscorea pentaphylla Voigt,

Liliaceae:

Chlorophytum glaucum Dalz.

Commelinaceae:

Commelina hasskarlii C. B. Cl.

C. maculata Edgees.

C. suffruticosa Bl.

Cyanotis concanensis C. B. Cl.

C. fasciculata (Heyne ex Roth) Schulte.

Murdannia spirata (Linn.) Bruckn.

Arecaceae:

Phoenix Sp.

Typhaceae:

Typha angustata Bory and Chaub.

Eriocaulaceae:

Eriocaulon dianae Fyson

E. minutum Hook. f.

E. rithoieanum Ruhl.

E. sieboldianum Sieb. et Zucc. ex Steud.

E. stellatulum Koern.

Cyperaceae:

Carex filicina Nees var. glaucina (Moeck.) Kuek.

Cyperus adulatus Kern.

C. cyperoides (Linn.) O. Kuntze var. sub-compositees (Cl.) Kuek.

C. difformis Linn.

C. distans Grah.

C. flavidus Retz

C. iria Linn.

C. malabaricus (Cl.) Cooke.

C. pangoreii Roxb.

C. pumilus Linn.

C. triceps (Rottb.) Endl.

Fimbristylis woodrowii Cl.

Fuirena glomerata Lamk.

Poaceae:

Apluda mutica Linn.

Arthraxon inermis Hook, f.

A. lanefoliatum (Trin. Hochst.)

A. meeboldii Stapf.

A. nudus (Steud.) Hochst.

A. quartinianus (A. Rich.) Nash.

Arundinella metzii Hochst, ex Mig. A. pumila (Hochst.) Steud. Capillipedium huegelii (Hock.) Stapf. Coix lachyma-jobi Linn. Cynodon dactylon Pers. Dichanthium armatum (Hock. f.) Blatt. et. MCC. Digitaria stricta Rath et R. and S. Dimeria ornithopoda Trin. D. stapfiana C. E. Hubb. ex Pilger Echinochloa colonum (Linn.) Link. E. frumentacea Link. Eleusine indica (Linn.) Gaertn. Eragrostis japonica (Thunb.) Trm. E. unioloides (Retz.) Nees ex Steud. Eulalia fimbriata (Hack.) O. Ktge. Garnotia stricta Brongn. Heteropogon contortus (Linn.) P. Beauv. H. triticeus (R. Br.) Stapf. ex Craib. Indochloa oligantha (Hochst.) Bor. Isachne elegans Dalz. I. globosa (Thunb.) O. Ktze. I. gracilis C. E. Hubb. Ischaemum indicum (Houtt.) Merr. Jansenella griffithiana (C. Muell.) Bor. Manisuris forficulata C. E. C. Fischer, Oplismenus compositus (Linn.) Beauv. Paspalum compactum Roth. var. fimbriatum Bor. Pogonachne recemosa Bor. Pseudanthistria heteroclita (Roxb,) Hook, f. Pseudodichanthium serrafalcoides (Cooke et. Stapf.) Setaria glauca (Linn.) P. Beauv. S. italica (Linn.) P. Beauv. S. tomentosa (Roxb.) Kunth. Spodiopogon rhizophorus (Steud.) Bor. Themeda quadrivalvis (Linn.) O. Krze. Tripogon capillatum Jaub, et. Speach. T. lisboae Stapf. Triplopogon ramosissimum (Hack) Borm. Gnetanceae (Gymnospermae) Gnetumula Brongn.

6.7: Ornamental Plants and Vegetation of Dangi Hills:

Harishchandragad, Ratangad, Aundha-Patta fort, Kalasubai, Rajur all lie in 'Dangs' of Akola taluka. The flora and ornamental plants of these places were collected by V. D. Vartak (1971) and has published a paper on them in Journ. Poona Univ., Sci. and Tech. Section No. 40, 1971, pp. 17—184. He had approached Harishchandragad from Akola and had collected 800 plants in the Dangi Hills covering wider area than covered by Billore and Hemadri (1969). Out of these, 70 species have been described as ornamental besides the common ones like Ceiba malabarica.

The habitant plants at Kalasubai, Ratangad, Harishchandragad, Rajur, Pend-Shet etc. are so different that the plant communities there differ widely. There are several small and large platforms on hill tops at different heights e.g. at Pachnai, Kedarnath temple, below the conical top of Kalasubai etc. Plenty of grass, herbs and few shrubs grow on them, but they contain some rare temperate elements like Delphinium indicum, Clematis wightiana, Thallictrumn dalzellii etc. The soil is very

shallow hardly a few inches and gets washed away by high rains and winds. Colourful flowers of Swertia minor, Swertia decussata, Paracaryum malabaricum, bulbous lily—Scilla indica, Hitchemia caulina, Ceropegia tuberosa, Habenaria rariflora, H. heyneana, H. grandiflora, Curcuma pseudomontana are quite common in rainy season.

The exposed areas along the hill slopes on upper flats have Delphinium, Senecio dalzellii, S. grahami make beautiful carpets. Climbers like Porona malabarica, Merremia umbellata form small tufts of creeping plants.

But really good flora of Kalasubai and other Dangi hills is in axillary coupes between two parallel hill slopes called Zure and in the valleys. Tropical evergreen small-leaved species mostly grow here. Only a few tree species like Careya arborea, Terminalia crenulata occur. They form isolated pockets or patches of semi-evergreen or evergreen plants. but nowhere outside Zure on exposed slopes. They are the counterparts of Sholas in Nilgiris. Should there be some protected flat ground, bowers of Lagerstroemia parviflora and Olea dioeca are formed, In the valleys Trewia polycarpa, Wrightia tinctoria, Careya arboresa, Litsea zeylanica, Pongamia glabra, Mangifera indica, Actinodaphne angustifolia form semi-evergreen forest. On the sunny slopes of valleys Eranthemum rosens, Adelocaryum coelastrum, olacenum or Coix lachrymajobi, Plumbago Centratherum, Phyllzeylanica, Moghania strobilifera grow crowded. Root parasite Christisonia lawii grows on underground parts of bushes. The undergrowth consists of two ferns Pteris quadriaurita and Tectaria macrodenta, and a small grass. The valleys and ravines being deep, there is good moisture in the weather The trunks of trees and branches are fully covered by mosses and epiphytic orchids. The mosses are yet to be studied. Epiphytic orchids are Aerides crispum, Aerides maculosum and Dendrobium falcata. Creepers of Tylophora dalzellii spread on trees.

In open, cleared areas in forest Lobelia nicotiaenifolia, Gloriosa superba, Asparagus racemossus grow. They merge with drier areas having Woodfordia fruticosa, Clerodendron serratum, Thespesia lampas, and Glochedion hohenackeri, Olea dioeca and bamboos. They form thickets and bowers on small open areas at mid-altitude flats. Porana racemosa, Argyreia strigosa grow at higher level. A number of grasses grow all over where there is little soil on sunny side, but not much on the other side at Konkankada of Harishchandragad. It has a steep drop of rocks several hundred metres down; there is no soil and rocks dry up as soon as the showers stop.

However, where the rocks are moist due to continuous water trickling from the top, Begonia crenata, Impatiens pusila, Ammania floribunda, Adiantum philippensis, Burmannia sp., grow in tufts in crevices and ledges of rocks due to water seeping through them. They last till the water is available. But very remarkable is the occurrence of Terniola zevlanica and Dierea dichotoma, both belonging to family Pedostemaceae, abundant in South Indian Ghats and in Ceylon. It seems that they have reached the northerly limit of distribution here. They are found on rocks in evergreen or semi-evergreen forest streams.

At places where soil gets accumulated in large quantities, and is not washed down, *Pimpinella tomentosa*, *Begonia crenata*, or *B. striatula* grow with grasses and small Cyperi. In deep forest shades *Lastrea zeylanica*, *Hamiltonia suaveolens*, *Habenaria grandiflora* are found.

In moist and temporary water logged places Exacum bicolor, Exacum petiolair, Stemodea viscosa, Sopubia delphinfolia, Ramphicarpa longifoliata, Dysophylla stellata grow mixed with grasses and sedges.

The vegetation of Dangi hills thus is unique in many respects. It has relict species of moist deciduous or evergreen vegetation such as Trewia polycarpa, Careya arborea which are broad-leaved, and Ligustrum neilgherrense, Olea dioeca which are small-leaved; but both grow in isolated pockets in valleys and ravines. Temperate elements like Impatiens scapigera, Delphenium grow on high top plateaux above 3000' and monsoon ephemeral flora grows above 2000'. Senecios grow at the same altitude and are tropical as well as temperate species. Mixed semi-evergreen vegetation slowly leads to dry deciduous vegetation towards Rajur. There are some relict species. The vegetation in valleys contains evergreen or semi-evergreen species. Other outer areas have dry scrub or grassy plains. They are really the counterparts of Sholas of Nilgiris. They are responsible for Hooker and Thomson (1855) considering Mawals as a separate sub-unit of flora. are worthy of intensive investigation from various points of view besides those studied by Billore and Hemadri (1969) and Vartak (1971).

Wild Ornamental Plants From Harishchandragad, Ratangad and Dangi Hills (after Vartak, 1971)

Ranunculaceae:

Clematis wightiana Wall. *Thalictrum dalzellii* Hôok. Delphinium dasycaulon Frees.

Polygalaceae:

Polygala persicariaefolia DC.

Malvaceae:

Abutilon polyandrum W. and A. Thespesia lampas Dalz. and Gibs.

Malphigiaceae:

सत्यमव जयन Aspidopteris cordata A. Zuss.

Balsaminaceae:

Impatiens scapigera Hook.

Rutaceae:

Murraya paniculata Jacq.

Papilionaceae:

Crotalaria retusa Linn. Indigofera pulchella Roxb. Smithia purpurea Hook. S. setulosa Dalz. Cylista scariosa Dalz. Moghania strobilifera St. Hill.

Crassulaceae:

Kalanchoe olivacea Dalz.

Melastomaceae:

Sonerila scapigera Hook.

Lythraceae:

Ammania floribunda CL. Woodfordia fruticosa Kuiz. Lagerstroemia parviflora Roxiv.

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Lacythidaceae:

Careya arborea Roxb.

Begoniaceae:

Begonia crenata Dryand.

Umbelliscrae:

Pimpinella tomentosa Dalz. Peucedanum grande Clarke. Heracleum pinda Dalz.

Rubiaceae:

Anotis lancifolia Hook.
Pavetta indica Linn.
Hamiltonia suaveolens Roxb.

Compositae:

Conyza stricta Willd.
Centratherum phyllolaenum Benth.
Cyathocline purpurea Kuntz.
Cyathocline lutea Law.
Notonia grandiflora DC.
Senecio grahami Hook.
S. dalzellii Clarke.
Lobelia nicotianaefolia Heyne.

Plumbaginaceae:

Plumbago zeylanica Linn.

Oleaceae:

Ligustrum neilgherrens Clarke.

Apocynaceae:

Holarrhena antidysenterica Wall, Wrightia tinctoria R. Br.

Asclepiadaceae:

Ceropegia bulbosa Roxb.

Exacum bicolor Roxb.

Gentiniaceae:

E. lawii Clarke. E. petiollare Griseb. Swertia decussata Nimmo.

Boraginaceae:

Paracaryum malabaricum Clarke. Adelocaryum coelestinum Brandis.

Convolvulaceae:

Porana malabarica Clarke.
Merremia umbellata Hall.

Scrophulariaceae:

Stemodia viscosa Roxb. Sopubia delphinifolia G. Don. Rhamphicarpa longiflora Benth.

Orobanchaceae:

Christisonia lawii Wight:

Lentibulariaceae:

Utricularia reticulata Smith:

Acanthaceae:

Eranthemum roseum R. Br. Thelepaepale ixiocephale Brem, Carvia callosa Brem. Barleria lawii T. Anders, Asystasia dalzelliana Santapau. Ecbolium linneanum Kurz var. dentata Clarko Justicia betonica Linn.

Verbenaceae:

Callicarpa tomentosa Murray. Clerodendron serratum Spreng.

Labiatae:

Pogostemon plectranthoides Desf. Dysophylla stellata Benth. Colebrookea oppositifolia Smith. Leucas montana Spreng.

Polygonaceae:

Polygonum glabrum Willd.

Elaeagnaceae:

Elaeagnus conferta Roxb.

Orchidaceae:

Dendrobium barbatulum Lindl.
Aerides crispum Lindle.
A. maculosum Lindl,
Habenaria rariflora Rich.
H. heyneana Lindl.

Zingiberaceae:

Hitchenia caulina Baker. Curcuma pseudomontana Graham.

Liliaceae:

Gloriosa superpa Linn. Chlorophytum glaucum Dalz. Asparagus racemosus Willd.

Araceae:

Remusatia vivipara Sch.

Eriocaulaceae:

Eriocaulon indicum Moldenke.

Cyperaceae:

Cyperus exaltatus Retz. var. divers.

Filicineae:

Adiantum philippens Linn. Aleuritopteris farinosa Fee. Pteris quadriaurita Retz. Lastrea eriocarpa Docne. Tectaria macrodonta C. Chr.

Besides these, there are also some common handsome flowering trees such as Bombax ceiba, Butea monosperma, Erythrina stricta, Pongamia glabra, Cassia fistula etc. which are commonly known.

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1. FLORA OF SHOLAPUR DISTRICT:

Arid climate of Sholapur, rich black cotton soils, low irregular rainfall, Ramling Hill and its flora.

7.1: Climate, Soil and Rainfall

The district is hemmed between Satara, Sangli, Pune, Ahmednagar, Osmanabad, and Gulbarga (Karnatak State). Sholapur district is rather dry but has very rich, fertile black cotton soil. The average annual rainfall is 23.00". There is a great variation in annual rainfall from year to year and place to place. The temperatures are high, average maximum being 39.90°C. The district lies in the famine zone with Bijapur, Ahmednagar and eastern parts of Pune district. The vagaries of rainfall and high temperature do not allow continuous growth of plants.

Once in three years the crop is abundant, because of the fertile, deep black cotton soil. There is a tendency for the salt to effervesce, making the soil at the surface unsuitable for plant growth. The whole district is plain. There are no hills worth the name, except Ramling, which is a small hill about 25.6 km north-east of Barshi, situated on a spur of Balaghat range of Sahyadris. The plants of this place were collected and described by Prof. S. D. Bhagwat and are given below

There is a Forest Nursery at Ramling which has introduced many ornamental trees like Gulmohor, *Peltophorum*, *Casuarina* on the hill here. There is Ramling temple, much sacred to the Lingayat community. Many trees are planted around the temple also. There are a few seasonal streams which dry up but two streams on the hill, Ramling *odha* and Nagzari do not dry up even when several others dry up after December.

7.2: Flora of Ramling Hills:

This is a typical of Sholapur area which is so dry. Ramling is a small hill 25.6 km N.-E. of Barshi. It is situated on the Balaghat range of Sahyadris. Its altitude is 2177 feet above the M.S.L. The hills are barren at the top. Ramling hill is covered by some important commercial and medicinal plants, such as Gardenia lucida, Anogeisus latifolia, Terminalia arjuna. More important species occur in the shallow valleys, some occur on the plains. They represent the flora of plains in the district. The vegetation of Ramling is of dry deciduous type bordering on scrub. In monsoons it is green. The rainfall is about 30". A striking ephemeral flora appears during monsoons. The ephemerals flower suddenly. They are short-lived, as the plants bear flowers, fruits and seeds quickly, and disperse them. After the seed dispersal all of them die. There is no vegetation except parched grass and ephemerals. For the rest of the year hills and plains look desolate. Many ephemerals belong to Compositae and tuberous Liaceae, but the hill top is barren. There are Acacia catechu, Zizyphus xylocarpa, Gymnosporia montana, Carissa congesta, Fluggea leucopyrus and Sirrus pallida and some Shrubs and climbers like Daemia extensa, Marsdenia (Dragea) volubilis, Rivea hypocrateriformis and Cocculus hirsutus.

Some trees grow on slopes and along Ramling stream going into valley. They are Boswellia serrata, Acacia catechu, Sizygium cumini, Cassia fistula, Zizyphus xylocarpa, Z. oenoplia, Salamalia malabarica, Carissa congesta. Some herbs like Cleome simplicifolia, Anisochillus carnosus are common. On slopes Sarcostemma acidum, Caralluma fimbriata, Exacum pumilum, Smithia conferta occur. Two ferns Actinopteris dichotoma and Adiantum capillus veneris grow in the ledges of rocks. The new plants introduced in the area are Jacaranda ovalifolia, Tamarindus indica, Ficus tsiela, Cissus tomentosa, Grewia tilaefolia, Gloriosa superba, Gardenia lucida etc.

The plants seen along the railway track are mostly herbaceous such as Bidens pilosa, Acanthospermum hispidum, Xanthium stumarum, Rhyncosia sp. Other herbaceous plants are Indigofera linifolia, Euphorbia hirta, Polygala chinensis, P. minima, Phyllanthus lawii, Echinops echinatus, Alysicarpus sp., Boerhaavia diffusa, Portulaca oleracea, Indigofera cordifolia, Lepidagathis mitis. The small trees noticeable are Cordia dichotoma, Glossocordia lineifolia, Pterocarpus marsupium. these plants Anacardium occidentale, Delonix regia. Jacaranda mimosifolia are cultivated.

It will be seen that the list contains a large number of dry deciduous species as those on dry hills of Ahmednagar. The full list of plants has been given by Bhagwat (1968) in "The study of Ramling plants" in Shivaji Univ. Journ. 4. 50-57, 1968. This is quoted below. The flora consists of 238 species belonging to 60 families of flowering plants, and only two xeric ferns, Actinopteris dichotoma and Adiantum cappilus, Avenezia. The vegetation is typically dry deciduous or scrub. The herbaceous vegetation whether on slopes or hill top is ephemeral.

Only a few thorny scruby plants survive the heat of summer and a few geophilous Liliaceous tubers which appear again in August.

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Flora of Ramling Hill Areas:

Menispermaceae:

Tinospora cordifolia (Willd.) Miers.

Cocculus hirsutus Diels.

Cruciferae:

Brassica nigra Koch.

Capparidaceae:

Cleome simplicifolia (Camb.) Hook. and F. and Th.

Cleome viscosa L.

Moringaceae:

Moringa oleifera Lamk.

Polygalaceae:

Polygala persicarifolia DC.

Polygala chinensis L. Polygala erioptera DC.

Caryophyllaceae:

Polycarpea corymbosa Lamk.

Portus acaceae:

Portulaca oleracea L.

Portulaca tetrafida L.

Malvaceae:

Abutilon indicum Sweet. Hibiscus rosa sinensis L. Thespesia populnea Soland.

Sida veronicifolia Lamk.

Sida acuta Burm.

Bombacaceae:

Salamalia malabarica (DC.) Sch. and Endl.

Tiliaceae:

Grewia tiliaefolia Vahl. Grewia pilosa Lamk. Triumfetta bartramia Linn. Corchorus olitorius L.

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Malpighiaceae:

Aspidopteris cordata A. J

Zygophyllaceae:

Tribulus terrestris L.

Oxalidaceae:

Biophytum sensitivum (Linn.) DC.

Rutaceae:

Eagle marmelos L.

Burseraceae:

Boswellia serrata Roxb.

Meliaceae:

Azadirachta indica A. Juss.

Melia compositae Willd.

Celastraceae:

Gymnosporia montana Benth.

Elaeodendron glaucum Pers. Syn. V.

Rhamnaceae:

Zizyphus mauritiana Lamk.

Z. xylocarpa Willd.

Z. cenoplia Mill.

Ampelidiaceae:

Cissus pallida Planch.

Cissus tomentosa Vahl.

Cissus elongata Wall.

Sapindaceae:

Cardiospermum halicacabum L.

Anacardiaceae:

Mangifera indica L.

Anacardium occidentale L.

Papilionaceae:

Heylandia latebrosa DC.

Indigofera linifolia Retz. I. cordifolia Heyne.

I. glandulosa Willd.

I. trita L. F.

Tephrosia purpurea Pers.

Zornia diphylla Pers.

Alysicgarpus tetragonolobus Edgew.

A. ru aosus DC.

A. pubescens Law.

Erythrina indica Lamk.

Butea monosperma Kuntz.

Atylosia scarabaeoides Benth.

Rhynchosia minima DC.

Dalbergia sissoo Roxb.

Dalbergia latifolia Roxb.

Crotalaria orizensis Willd.

Crotalaria filipes Benth.

Abrus precatorius L.

Psoralea corylifolia L.

Pterocarpus marsupium Roxb.

Desmodium latifolium DC.

Desmodium diffusum DC.

Phaseolus aconitifolium Jacq.

Phaseolus trilobus Ait. Crotalaria chinensis L.

Caesalpinnae:

Caesalpinia pulcherima Swartz.
Caesalpinia sepiaria Roxb.
Delonix regia Raf.
Parkinsonia 'aculeata L.
Cassia auriculata L.
Cassia fistula L.
Cassia sophora L.
Cassia sophora L.
Cassia siamia Lamk.
Bauhinia racemosa Lamk.
Bauhinia tomentosa L.
Tamarindus indica L.
Hardwickia binata Roxb.
Peltophorum inerme Naves.

Mimosae:

Prosopis specigera L.
Mimosa hamata Willd.
Acacia arabica Willd.
Acacia leucophloea Willd.
Acacia catechu var. Cundra Prain.
Pithecolobium dulce Benth.
Samanea saman Merr.

Combretaceae:

Terminalia arjuna W. und A.
Anogeissus latifolia Wall.

Myrtaceae:

Syzygium cumini (Linn.) Skeels. Eucalyptus hybrida.

Lythraceae:

Ammannia baccifera L. Lagerstroemia parviflora Roxb.

Ficoidae:

Mollugo pentaphylla L. Trianthema monogyna L.

Umbelliferae:

Hydrocotyle asiatica L.

Rubiaceae:

Oldenlundia corymbosa L.
Oldenlandia aspera DC.
Gardenia lucida Roxb.
Borreria stricta K. Sch.
Morinda citrifolia L.
Plectronia wightii Cooke.
Anotis foetida Bth and HK.

Compositae:

Tridax procumbens L.
Eclipta alba Hask.
Cyathocline purpurea (Don.) C. Kuntz.
Caesulia axillaris Roxb.
Xanthium strumarum L.
Gnaphalium indicum L.

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Ageratum conyzoides L. Glossocordia linearifolia Cass. Lagasca mollis Cav. Acaenthospermum hispidum DC. Vernonia cinerea Linn. Echinops echinatus Roxb. Sonchus oleraceus L. Tricholepis amplexicaulis Clarke. Certhamum tinctorius L.

Plumbaginaceae:

Plumbago zeylanica L.

Oleaceae:

Nyctanthes arbor-tristis L.

Apocynaceae:

Carissa congesta DC.
Plumeria acutifolia Woodson.
Vinca pusilla Murr.
Anodendron paniculatum A. DC.

Asclepiadaceae:

Hemidesmus indicus R. Br.
Daemia extensa R. Br.
Sarcostemma acidum Veight.
Marsdenia volubilis T. Cooke.
Caralluma fimbriata Wall.
Calotropis gigantia R. Br.
Gymnema sylvestre R. Br.

Gentianaceae:

Exacum pumilum Griesb. Canscora diffusa R. Br. Enicostemma littorale Bl.

Boraginaceae:

Heliotropium indicum L. Heliotropium supinum L. Trichodesma indica R. Br. Cordia dichotoma Forst.

Convolvulaceae:

Rivea hypocrateriformis Choisy. Evolvulus alsinoides Convolvulus arvenis L.

Solanaceae:

Solanum nigrum L. Solanum xanthocarpum Schard. Physalis minima L.

Scrophulariaceae:

Verbascum coromandelianum Kuntze. Herpestris moniera Dalx. and Gibbs. Striga densiflora Benth. Striga euphresioides Benth. Striga gesneroides Vatke. Sopubia delphinifolia G. Don. Lantana camara L.

Bignoniaceae:

Dolichondrone falcata Seem. Jacaranda ovalifolia R. Br. [O. J. mimosifolia] Millingtonia hortensis L.

Martyniaceae:

Martynia diandra Glox. Sesamum indicum L.

Acanthaceae :

Justicia simplex Don.
Lepidagathis cuspidatus Nees.
Lepidagathis mitis Dalx.
Asteracantha longifolia Nees.
Strobilanthes sp.
Rungia elegans Dalz.
Barleria cristata.

Verbenaceae:

Vitex negundo L.
Tectona grandis L.
Lippia nodiflora L.
Clerodendron phomidis L.
Lantana camara L.

Labitae:

Orthospiphon pallidus Royle Anisochillus carnasus Wall. Ocimum sanctum L. Leucas biflora R. Br. Leucas longifolia Benth.

Nyctaginaceae :

Boerhaavia diffusa L.

Amaranthaceae :

Celosia argentea L.
Achyranthes aspera L.
Amaranthus spinosus L.
Amaranthus blitum L.
Amaranthus paniculatus L.
Pupalia astropurpurea Moq.
Digera arvensis Forsk.
Alternanthera sessilis R. Br.
Aerua lanata Juss.
Aerua javanica Juss.

Santalaceae:

Santalum album L.

Euphorbiaceae:

Euphorbia neriifolia L.
Euphorbia hirta L.
Euphorbia thymifolia L.
Pedilanthus tithymelodides Poit.
Euphorbia elegans Spreng.
Euphorbia geniculata orteg.
Euphorbia hypericifolia L.
Phyllanthus niruri L.
Phyllanthus lawii Grah.
Phyllanthus maderaspatensis L.
Jatropha curcas L.
Ricinuscommunis L.
Acalypha malabarica Muell.
Acalypha ciliata Forsk.

Moraceae:

Ficus religiosa L.
Ficus bengalensis L.
Ficus glomerata Roxb.
Ficus tsiela Roxb.

Casuarinaceae:

Casuarina equisetifolia Forst.

Hypoxidaceae:

Curculigo orchioides Gaertn.

Agavaceae:

Agave Sp.

Liliaceae:

Gloriosa superba L.
Iphegenia indica A. Gray
Iphegenia pallida Baker
Scilla indica Baker
Urginea indica Kunth
Chorophytum tuberosum (Roxb.) Baker
Alae vera L.

Commelinaceae:

Cynotis tuberosa Schult. Cynotis fasciculata Schult, Commelina nudiflora L. Commelina benghalensis L.

Eriocaulaceae:

Eriocaulon sp.

Typhaceae:

Typha angustifolia Bory.

Cyperaceae:

Cyperus corymbosus Rottb. Fimbristylis monostachys Fuirena wallichiana Kunth

Graminae:

Andropogon pumilus Roxb.
Aristida funiculata Trin & Rupr.
Arthraxon sp.
Coix lachryma-jobi L.
Cymbopogon martini Stapf.
Chrysopogon montanus Trin.
Dactyloctenium aegiptiacum Willd.
Eulalia argentea Brogn.
Eragrostis sp.
Heteropogon sp.
Melanocenchris jacquemontii Jaub.
Polytoca barbata Stapf.
Setaria sp.

Polypodiaceae:

Actiniopteris dichotoma Bedd. Adiantum sp.

8. CONCLUDING REMARKS ON THE FLORA OF DESH DISTRICTS

Considered as a whole the vegetation of Desh districts has developed under semi-arid conditions. It is dry deciduous mostly except in the regions adjacent to Sahyadri ranges where the rainfall is high and has

resulted in the creation of discontinuous pockets of semi-evergreen or moist deciduous forests. They are not rich and continuous but rather irregular.

A special feature of the flora of northern part of Sahyadris is the Dev Raies. Their vegetation is different from that of the surrounding areas. They have conserved the ancient types like *Gnetum ula*, *Entada pursaetha*, *Haligerna grahami*, *Conarius wightii* (Mahabale 1979).

They represent climax vegetation of the past ages, and are not the climatic climax of the present time. The vegetation of Kolhapur, Satara and Pune districts is varied and rich; that in Junnar area, Purandar and Harishchandragad has preserved some endemic species which deserve to be fully studied for their physiology and autoecology.

The rich vegetation of Malabar botanical province in South Konkan slowly changes to dry or semi-arid vegetation as one goes North. Sahyadri ghats have preserved many rare plants of different taxa and are a veritable treasure of different plants, their ecotypes and possibly mutants.

सत्यमेव जयत

CHAPTER IX-GENERAL CONSIDERATIONS

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CHAPTER IX—GENERAL CONSIDERATIONS

This Section deals with general considerations regarding the plants of Maharashtra, their classification, flora, floristic analysis, vegetation, certain special plant groups, history of Botany and Palacobotany in Western India, and early botanists who have contributed to our knowledge of Botany and plants of this State.

Some noteworthy floras such as the flora of hill tops, ghat flora, monsoon ephemerals, aquatic plants have been described. The distribution of principal families and plants has been given in relation to those in the adjoining States. Striking families Podostemaceae, Orchidaceae, Balanophoraceae, Scrophulariaceae have been considered.

A large number of open grasslands occur throughout the State. Their fodder grasses have been enlisted. Similarity between grasses of Assam and grasses of the Sahyadri region is pointed out. Different elements in the flora of Maharashtra, Tropical, Subtropical, Temperate and relict species have been considered.

Another important section of this chapter deals with the plants of special habitats, such as, drought resisting plants, water plants, xerophytes and succulent plants, parasites etc. Exotic and endemic plants, wild tuberous and other edible plants, medicinal plants, honey yielding plants, plants in Dev Raies are given. Importance of these various plants lies in their relation to the present day plants in plant breeding and plant introduction, weed control, ethno-botany and pollution control. Some wild beautiful plants worth introducing in botanical gardens and parks have been noted.

In Botany these days, there are some newer disciplines, such as, Chemotaxonomy, Numerical taxonomy, Aerobiology, Palynology, Bee Botany, Ethnobotany etc. They are briefly considered. Crop plants and crop pattern, fruit trees, their wild parents, their original home have been given. Some botanically interesting plants are likely to become extinct. Need for their conservation and preservation of endemics is emphasized.

The present day flora is the result of various changes in geological, climatic and historical factors. Fossil floras and Archaeological plants help in understanding them. The fossil floras in the State are briefly described, mainly Mesozoic in the Wardha-Vainganga-Godavari Valley and Tertiary flora found in the Deccan Intertrappean Series around Nagpur. Quaternary plants found on calcareous shales in Pravara at Sangamner, those in Travertine tufa on Mula river bank, at Kotul in Ahmednagar district have been described specially.

Several river valley projects are going on in the State. The construction of dams on them at different places in this and adjacent States on Koyna, Narmada, Tapi, Pench, Vainganga, Kukadi, Krishna, Bhima and others are bound to make changes in aspects of our vegetation. Some parts of it may even vanish, these need close study. Attention is drawn to them also.

The titles of different topics dealt with in this chapter indicate the range of subjects covered under General considerations, viz., (1) Taxonomic, (2) Floristic, (3) Economic, and (4) Historical. In short, they deal with the major problems concerning the plants of this State.

A. SOME TAXONOMICAL CONSIDERATIONS—GENERAL

Throughout the present work we have considered plants in a synoptic way, and not with a view to give their detailed descriptive taxonomy, as that would need reference to localities and to herbarium sheets in Indian herbaria and in the herbarium of the Western circle of Botanical Survey of India, Pune, and also to plants in other herbaria.

The Flora Indica of J.D. Hooker was completed by about 1897. It is largely based on the Bentham and Hooker's system of classification of plants. It is used throughout the erstwhile British colonies and is still being followed. The whole collection of plants at Kew consisting of several millions of specimen and types of Indian plants at Kew, are also arranged according to the Bentham and Hooker's system of classification. It is still the authentic and authoritative official system followed in the Indian National Herbarium at Calcutta. It is very necessary therefore, that we should know it in a little more detail, its merits and defects and short-comings. It is considered here synoptically as in the Introductory Essay to the Flora of British India by Hooker and Thompson (1855), but not as in Cooke's (1901-1908) Flora of the Bombay Presidency, wherein all the known localities and herbarium material are cited and many important places from which plants were collected are referred to in the text of that work.

Towards the middle of last century Charles Darwin published his wellknown book, "The Origin of Species" in 1859. It created a sensation in the world of science. The natural outcome of it was, the people came to believe in Evolution, and that changed their outlook towards science then in existence. The same thing happened in Botany also. Till that time the sytems of classification that were in vogue were based on the idea of constancy of species. Darwin clearly showed that it was not true. The species are variable and mutable and that the present day species have been derived from their ancestors existing in the distant past, with a change. At that time Palaeobotany was coming up as a separate discipline due to the efforts of French Botanists Brongniart (1770-1847) and the British botanist Williamson (1870). The result was that it became quite evident that many groups of plants differing from the present ones have had disappeared in long course of history, so that our attempts to prove or show that all the present day plants have been constant and are derived from exactly similar past plants had to be given up. But there was a lot of opposition to it. At that time influencial French taxonomist A.P.De-Candolle (1824-1873) had formulated a very elaborate system of classification of plants Prodromus systematis regni vegetabilis, since the days of Linnaeus. It runs into 17 large volumes wherein all the then known plants were classified and described. The various categories of plants formulated by Linnaeus and other taxonomists like Tournefort were then commonly used in France and Europe. They accepted species, order or Family, Class and Series as units of classification. But De-Candolle was a believer in the constancy of species as groups. Therefore, he was not in favour of arranging a system of classification of plants according to the idea of changeability of species which was the result of Darwin's work. However towards the end of his work he accepted the idea and changed his approach in his next work, though not in earlier volumes of "Prodromus".

Bentham was not a botanist by profession but an engineer. He had great interest in plants. Botany at that time was a compulsory discipline for medical students and so many well-known medical men were good

botanists e.g. Dr. Williamson, Dr. Gibson etc. Bentham had made huge collections which he parted to the Kew gardens and classified them as a member of the staff of the Royal Botanical Gardens at Kew.

Kew gardens at Richmond near London originally were the property of the King of England, Richard the Third. By the middle of 18th century, it got completely disfigured and deteriorated to a very great extent. As a result, the King parted with it and created a Trust for looking after it. Sir William Hooker (1785-1865), a British botanist, trained at Edinburgh and in-charge of the Botanical Gardens, Edinburgh, was appointed its first Director in 1841. Bentham, well versed in, taxonomy was appointed to be a member of the staff of the Royal Botanical Gardens at Kew. There came into existence by about 1869 a joint system of classification of plants named after Bentham and Hooker which is still used in English speaking countries.

The main features of Bentham and Hooker's system are: They divide the system into two divisions of seed plants Dicotyledons and Gymnosperms together, and Monocotyledons. They classified them into the then known genera of plants, about 97205, into various categories. They split the Dicotyledons into 6 Series, Monocotyledons into 8 Series and Gymnosperms into 4 Series. This was a new way of arranging. But it is to be remembered that every system of classification largely utilises the information and knowledge gained from the previous ones and tries to improve upon it. So did Bentham and Hooker's. Their full system as it is followed is given below separately. It should be noted, however, that this system has some defects in it, and also some novel points. The novelty is that it created new groups called Disciflorae and Monochlamideae. In the earlier classifications of Linnaeus or Tournefort there were also heterogenous groups. But Bentham and Hooker had put under Monochlamideae or Apetaleae all those families of plants which could not be classified properly into other groups. This is highly artificial and quite defective, because sometimes most unrelated plants or families are put together e. g. in Bixineae. Another interesting feature, which was wrong, is that Bentham and Hooker classified gymnosperms along with dicot flowering plants together as Spermatiphyta. They considered that the hermaphrodite flowers as those of Magnoliaceae or in fossil Williamsonia, to be more primitive, and unisexual flowers to be higher. Families such as Euphorbiaceae, Salicaceae were considered to be advanced. This was largely to suit the idea of Williamson that hermaphrodite flower of Williamsonia may be primitive. This was not accepted by authors of the phylogenetic system like Engler and Prantl. To them Amentifereae or plants bearing unisexual flowers in catkins were primitive than those with bisexual flowers of Magnolia or Williamsonia. Engler's system is arranged on this basis (1892). This is not the place to discuss the merits or demerits of the various systems, but only to point out the limitations and special features of them each. In Bentham and Hooker's system, gymnosperms are put together with angiosperms, as they both are seed-bearing plants and have two or more cotyledons, therefore, they are put together. This, of course, was never accepted by later taxonomists and they made Gymnosperms a separate Class or Division colateral with Angiosperms. But the easy way in which the Bentham and Hooker's system can be handled, irrespective of its phylogenetic implications, is the main reason why it is followed by many even today. It should be noted, however, that on the continent of Europe including Russia, Engler's phylogenetic system of classification is more popular and is widely followed.

We have been adopting Bentham and Hooker's system for two reasons: (1) Our type material* at the Indian National Herbarium, at Calcutta and that at Kew is based on Bentham and Hooker's system, (2) Classification followed in the authoritative flora of India, Flora Indica published by J. D. Hooker, son of the great British botanist Sir William Hooker (1785—1865) has followed it for describing 17,000 species India. This number has now certainly become still larger and till the authoritative floras of India as a whole, adopt, any system of classification, it is wise to use the same system. After all the taxonomy is the playground of botanist and taxonomists and change of names needs enormous previous literature at hand, which is rarely the case. Very often it only creates confusion in the minds of workers who have no access to all the early literature. Therefore the names as given in Bentham and Hooker's system in Flora Indica and in the Flora of Bombay Presidency by Theodore Cooke (1901-1908) or in the Flora of Khandala by Santapau (1967, 3rd Edition) are largely followed, supplemented by other accepted names here and there in The Flora of Hassan District by Rev. Father Dr. Cecil J. Saldanha (1976), or Index Kewensis. At present latest new system of classification of flowering plants is that of Cronquist, Zimmermann and Takhtajan (1966), but that is not adopted in the present work.

Distribution of taxa in Bentham and Hooker's 'Genera Plantarum is given below as in Bentham and Hooker's system of classification of Spermatophyta or Seed-bearing plants (1862-1893):

DICOTYLEDONS

- I. Polypetalae-Plants with free petals.
 - Series 1. Thalamiflorae. Hypogyneae. 33 Orders from Rannculaceae to Tiliaceae.
 - Series 2. Disciflorae—Receptacle or a disc present. 25 Orders from Geraniaceae to Moringaceae.
 - Series 3. Calyciflorae. Flowers generally perigynous, sometimes epigynous. 27 Orders from Rosaceae to Cornaceae.
- II. Gamopetalae—Corolla with fused petals.
 - Series 1. Inferae—ovary inferior. 9 Orders from Rubiaceae to Companulaceae.
 - Series 2. Heteromerae—ovary superior, carpels more than 2. 12 Orders from Ericaceae to Styraceae.
 - Series 3. Bicarpellatae. Ovary often superior with two carpels. 24 Orders from Oleaceae to Labiatac.
- III. Monochlamideae-Perianth simple.
 - Series 1. Curvembryeae—Embryo curved. 31 Orders from, Nyctaginaceae to Polygonaceae.
 - Series 2. Multiovulatae Aquaticae—submerged herbs single Order Podostemaceae.

^{*}Type material is a herbarium specimen on which original description or diagnosis of a species or Taxon is based as defined by Section 2 of the Rules of Botanical Nomenclature (1972).

- Series 3. Multiovulate Terrestres—Plants Terrestrial.
 3 Orders from Nepenthaceae to Aristolochiaceae
- Series 4. Micrombryeae—Plants with very small embryo 4 Orders from Piperaceae to Monimiaceae.
- Series 5. Daphnales—Ovary with a single ovule. 4 Orders from Laurineae to Elacagnaceae.
- Series 6. Achlamadosporeae—Pistil 1—celled, ovules 1-3. 3 Orders from Loranthaceae to Balanophoreae.
- Series 7. Unisexuals. Flowers unisexual. 9 Orders from Euphorbiaceae to Cupuliferae.
- Series 8. Ordines anomali or Anomalous families, Relationship, uncertain, 4 Orders from Salicacea to Ceratophylleae.

GYMNOSPERMAE

4 Orders. Gnetaceae, Coniferae, Cycadaceae and Ginkgoaceae.

Lawrence (1951) estimated 97,206 species of seed-bearing plants, others estimated 2 lakhs.

Before Linnaeus the species as units of plants taxonomy were recognised. but their denotations was not fixed. They used to apply them to various groups small or large. It was Darwin (1859) who gave proper meaning to the term 'species' and their evolution by variation, in his well known book "The Origin of Species". To each species Linnaeus gave two names, one generic and one specific. Before Linnaeus and Darwin the concept of species was there, but the method of nomenclature was not rigidly followed. There used to be one name for the Genus and another name for the species, the first one they called 'generic' and the other 'trivial' respectively. Sometimes there used to be three names or even four names for the same plants. This afterwards created confusion. this Linnaeus devised the rule of Binomial nomenclature which necessarily requires two names for a plant and a third name for the variety. The rule per genus et differentia, is now strictly followed except for the cultivated plants where they mention either the variety or the cultivated garden races or strains as cultivars. However, all biologists are not agreed as to the exact content of the different catagories of nomenclature such as genus, species, sub-species, cohort etc. The last term was introduced by De Candolle. There is a broad agreement as regards the term "Genus" which is considered by some to be a better unit in classification, and for the purposes of plants breeding rather than species. But opinions differ on this point, though it is largely agreed that genus is a larger and continuously evolving unit genetically. The 'Family' as a unit was brought into use later. Previously it used to be called 'Order', but now they call it 'Family'. This term has completely replaced the term 'Order'. Thus our present knowledge of taxonomic terms, their import have been brought into use, and a common understanding is stabilised, largely by the efforts of several botanists based on the ideas mentioned above. The term 'Taxon' is a generalised term for a unit or any category in Taxonomy. It is now preferred.

Leursen and others use an additional criterion for a 'Species' namely, the geographical distribution. Due to geographical isolation many

species tend to become endemic and get separated from an evolving complex of an original species, thus terms eco-types, bio-types, cytotaxonomic types, comparium have come into use, widening the use and meaning of a large species complex. The process of isolation of a species from its centre of origin is due to geographical barriers such as high mountains, oceans, deserts etc. Therefore, geographical distribution also is an important consideration for a species. Species which have poor means of migration get completely isolated from each other. The species of Bryophytes, mosses, algae are classified taking into consideration their geographical distribution. It should however, be remembered, that after all no classification can ever be complete or ideal phylogenetically, as our knowledge of the various reproductive mechanisms and life processes of plants continuosly goes on improving. New ideas are introduced and the classification gets modified. That is how the present concept of Biosystematics has come into existence. Our aim in taxonomy is to know plants as they have evolved in nature at a time, recognise them. and know their relationship with others which means Phylogeny, a term reach and is not likely to be reached.

Bentham and Hooker's system. Prantl or modified Bentham and Hooker's system of Hutchinson is immaterial from the view point of practical applicability. However, the final test of relationship between species and species, groups and groups lies in their ability to produce fertile progeny by crossing. do know at present that there are interspecific and rarely intergenetic crosses. But this is by way of exception. The normal rule is that the individual within a species complex — the genus — is or should be fertile. This still holds good and attempts to change genes experimentally is a long process. To alter thousands of genes of a species effectively in order to give requisite combination of characters will also be a still longer process of Bioengineering.

In "Genera Plantarum" of Bentham and Hooker the families, genera then known have been described. The tendency to split the families lumped together into different families, or to split different genera lumped together, to transfer species from one family to another, because our knowledge of their relationship is now better, has increased the number of species or Families put together before. Therefore it looks as if some new families have been discovered, but that is not necessarily the case.

Like Linnaeus or Lindleyan system of classification of plants, Bentham and Hooker system is based on gross morphological characters rather than on any artificial criteria such as the numbers of stamens of some vegetative characters. Its nomenclature also is relatively easy. It is based on the well-known work "Genera plantarum" of Bentham and Hooker (1862 to 1883).

Stated briefly, Bentham and Hooker's system of classification of Spermatophyta comprises 163 of Dicot families, 34 of Monocot families, together with 197 families of Flowering plants, and 4 Families of Gymnosperms or Gymnospermia which have 415 living species spread over 44 genera. It is considered a collateral group with Angiosperm.

Bentham and Hooker's system or classification of seed-bearing plants or Spermatophyta has been largely used in England, India and other English speaking countries like Australia, New Zealand or Singapore, because to change thousands of herbarium specimens in a large herbarium

is impracticable. Secondly, it is a very easy system to follow, as it is based on similarities of external morphological characters, although it is not strictly phylogenetic. On the continent of Europe, the phylogenetic system of Engler and Prantl is mostly followed.

In the Flora of the Bombay Presidency, Cooke (1901—1908) has recorded 127 families. Since then no new families have been discovered nor any family has been eliminated by the separation of Gujarat, Sind, Karnatak from the previous Bombay Presidency. The flora of Maharashtra now comprises flora of Marathwada and Vidarbha in addition to the flora of remaining old Western Maharashtra. Despite this, the total number of families has remained nearly the same, now estimated to be 144. At present botanists have estimated 144 families, 838 genera, 1939 species with 132 varieties in the Maharashtra region.

1. Interesting Families of Angiosperms in Maharashtra

In this part we shall deal with some general botanical problems connected with the plants in Maharashtra. The most striking feature in the topography of Maharashtra is the spread of Sahyadri ranges and their hill tops. The ascent of species from plains to hill top is not easy as compared to their descent from the crests to plains below. There is also a considerable disturbance to vegetation and even destruction by the local people, going on for centuries.

Second important feature noticeable here, on the Desh side, is the uniformity of dry deciduous forests, and some unique plant families in Sahyadris. There are about 417 families of angiosperms in the world and nearly 2 million species. J. D. Hooker has enumerated approximately 17,000 species of plants in India. They belong to about 127 families. Most of them are quite common to various regions. The largest family in India is the Orchidaceae having 1,500 species, but it is not so well represented in Maharashtra flora. The largest genera having maximum number of species in Maharashtra belong to Gramineae or Grasses. They occupy large areas. Next is Leguminoccae and third is Compositae followed by Rubiaceae and Acanthaceae. Orchidaceae stands fourth. Orchidaceae is a very interesting family biologically, due to its habit, mode of nutrition and method of pollination. Many orchids are epiphytic and some are terrestrial. Among the terrestrial genera. Habenaria is the largest genus having over 25 species in Maharashtra, Some are terrestrial and some are epiphytic. Among the epiphytic orchids Dendrobium is the largest genus of orchids in India, as well as in Maharashtra. Eria is another large genus of orchids in India, but is having only a few species-4 in Maharashtra. However, there are other large families like Verbenaceae, Rubiaceae, Combretaceae which are very important economically. The well-known timber tree Tectona grandis belongs to Verbenaceae and Adina cordifolia belongs to Rubia-Both are extremely important species from the view point of economy. Combretaceae is mostly woody. The strange thing about Rubiaceae and Verbenaceae is that they have equal number of tall woody and small herbaceous members. Some are extremely small and her-This is rather anomalous, as it does not easily fit in the system of classification of Hutchinson into Lignosae and Herbaceae. That only shows that a family may be having woody and herbaceous members at the same time. There are however, only few families which show this peculiarity. Another family which has woody trees, shrubs and herbaceous members is the Leguminoceae. The genus Cassia is a standing example. It has large woody trees like Cassia siamea or C.

fistula, shrubs like C. auriculata and also extremely small herbaceous species C. pumila. There is difficulty about the shrubs. The alternating periods of hot and cold climate possibly have reduced them to their present status as shrubs.

There are a few families in Maharashtra which have extremely small distribution or unique distribution. The smallest family of flowering plants both in size and differentiation of parts is the Lemnaceae. It has only two-three common genera Lemna represented by three species, L. minor, L. polyrhiza and L. trisulca. The other genus Wolffia as well as Spirodela are monotypic. They have no roots and look like some small green alga. This family, in spite of its small size, is very extensively distributed in fresh waters in Maharashtra in tanks, reseryours and rivers. It is carried to different places by floods or by legs of birds. It thrives also in brackish waters. This probably explains its spread far and wide. The only limitation on its distribution is put by its own ability to survive. If the ponds in which it grows get dried up, it dies; but survives somewhere else. The story of its biology is exactly the same as that of the small water fern Azolla pinnata. The third important family worthy of note is the Podostemonaceae. This family has discontinuous distribution, and its members are found on rocks in high torrential streams. In Maharashtra it is found in the streams of the Western ghats at high altitude and is represented by 5 genera. In Peninsular India it is represented by the genus Podostemon atter which the family has been named. But this genus is rarely found in Maharashtra. The other genera Griffithella, Hydrobryum Dicraeu are found in the streams at high altitude along the ghats in Sahyadris. Willis (1902) has based his 'Age and Area', hypothesis on the basis of the discontinuous distribution of the members of this family, inter alia its distribution in Peninsular India, at Shillong, Sri Lanka etc. The discontinuity in its distribution is very great and this family deserves special attention from the biological point of view. I is described in brief in subsequent pages.

The other important parts in this chapter deal with the fossil plants of Maharashtra. The most important thing to be noted in this connection is the fact that the geographical position of the Sahyadris has not changed along its longitudinal axis, and as such it still contains some important members in its flora which have continued right from the Tertiary period till today. Most of the present day Maharashtra flora is of Tertiary origin, largely of Miocene and post Pliocene and a few of Eocene origin. However, some plants have survived from the end of Cretaceous to present era and have stood all the vissicitudes of climate. The earlier floras of Maharashtra were along the banks of the Narmada, Krishna and Godavari rivers. They had many gymnosperms in the Gondwana period, but they have not survived, except perhaps only Gnetum ula.

Another peculiarity of the flora in Maharashtra is the general absence of gymnosperms. Those which are seen today are all cultivated. The only gymnosperm found wild in the flora of Maharashtra is Gnetum ula. This is, however not found in the deciduous forests all over Maharashtra, but only in the semi-evergreen forests and Dev Raies along the Konkan coast and on high top valleys. Strangely enough, it is found at Mahabaleshwar (Fitzgerald Ghat), in coastal strand forests of Jawhar, at Lonavala, Khandala, Amboli in hill top forests; but it is not found on the hill top of Matheran. This is not

easily explicable. It is also not found in forests elsewhere. Other three interesting families of Maharashtra are the Orchidaceae, Podostemaceae and Balanophoreceae. These families (in the flora of Maharashtra) are of special interest. Of these the Orchidaceae is large and Podostemacae and Balanophoraceae are small. They are briefly treated here.

(a) Orchidaceae:

This family has pretty flowers and floral mechanisms for cross pollination and different mode of mutation. It comprises 15,000 species in the world, spread over 480 genera. It is cosmopolitan in distribution, but is largely concentrated in Malaya, India, Sri Lanka and Africa. According to Hooker there are 1,600 species of orchids in India, and is the largest family in the Indian flora. The species are abundant in Himalayas, Assam and Western Ghats. They are both terrestrial and epiphytic, approximately equal in number. They produce adventitious roots from rhizome or pseudobulb. The leaves are generally leathery. Some have reedy stem three feet high. The epiphytic species cling by their roots to tree trunks on which they grow from very minute, light seeds carried away by wind in thick jungles. Roots are provided with special water storage tissue-exodermis. Some orchids are quite small e. g. Eria dalzellii. They form button like pseudobulbs. In Nilgiris there is one orchid which is hardly an inch in diameter. It has no leaves and has flat radiating greenish roots, arising from the little stem, which gives rise to a small floral stock bearing minute flowers Taeniophyllum (T. zoolinyeri?). Roots of some orchids are symbiotic or photo-synthetic. Some orchids store mucilage and others store food material in their root tubers e. g. Orchis palmata, or in pseudobulbs in epiphytic Erias, and of epiphytic orchid Rattenjyota growing in the neighbourhood of Girisappa Falls in Mysore. These bulbs are full of mucilage and are sold in Bombay market. They are used medicinally e. g. Orchis palmata roots (Punjab Salam) used as a tonic.

Flowers of *Dendrobium*, calantha, Arides maculosum and other species, Rhychostylis are very handsome and look like garland. Many species can be hybridized. A hybrid orchid called Brassocattaelia is derived from three different genera Brassawola, Cattleya and Laetra by crossing.

Fruit of orchids is an inferior capsule called diplotegia Pods e. g. Vanila pods are famous for fragrance they give to ice-cream. They are extracted for obtaining essence of the same name used in ice-cream, pastries and cosmetics. It is an epiphytic orchid which climbs 30 feet on trees with the help of its clinging roots.

Orchids have one or two stamens. There are thus two kinds of them, monandrous and diandrous. Their pollination is effected with the help of insects touching a peculiar structure called gynostemium. They are attracted by the odour of flowers, some having foul smell e. g. Acampe ochreata; and some have good odour. There is a cultivated orchid called Peristeria elata or Dova Orchid, which produces extremely fragrant flowers. It is a terrestrial orchid with large pseudobulbs or tubers. A floral stalk comes out of large, 5-6 leaves, and bears 8—10 fragrant, white flowers in succession. Their aroma fills the room and lasts nearly 15 days.

Cooke (1901—1908) in the Flora of the Bombay Presidency has described 74 orchids, but recent! Santapau and Kapadia (1966) in their

paper "Orchids of Bombay" (Govt. Publication, Calcutta), have revised and described the orchids of Bombay as comprising 123 species belonging to 42 genera. Konkan, Western Ghats, Mahabaleshwar are the favourite places of orchids. They are prohibited for collecting or cutting by the Forest Department. There they grow terrestrially as well as epiphytically, they perennate by tubers, bulbs or pseudostem. Malaya is the biggest exporter of orchids, especially Singapore, where there is a special Orchid Park. The people there propagate them by callus culture.

A special section of terrestrial orchids consists of the saprophytic orchids. Many terrestrial orchids harbour fungi. Remarkable among them are parasite on parasite orchids like *Neottia*, *Epigonum* etc. The fungus grows on grass roots and on these grasses orchids grow parasitically. These orchids thus show double parasitism, a superparasitism. Orchid family represents the highest level of evolution among monocots and has become the symbol of imperialism. Winston Churchill, the imperialist, always used to wear an orchid flower in his button hole.

Orchids are often cultivated out of fancy in hot houses. They need shade, shelter and diffused light. There is National Orchidarium at Darjeeling. There is also one at Shambagnur near Kodaikanal in Catholic seminary. For enumeration see list of orchids compiled by Santapau and Kapadia (1966). A natural Orchidarium exists at Bili-girirangan, Ercaud, Castle Rock and Mahabaleshwar in thick woods.

(b) Podostemaceae:

This is a unique family of flowering plants as its plants have thalloid structure looking like Anthoceros. They have no roots or distinct stem or leaves. The thalli grow only in substrate rocks in fast moving streams or torrents. They are highly adapted to aquatic conditions and to arid conditions when torrents stop flowing. By about December-January receding waters of streams cease to flow and the plants are dried up as white patches on rocks, where water flowed before, looking like lichens or dried fleshy liverworts. They are confined to high altitude, 3,000 and above.

Plants have minute leafy, out-growths with small seeds. Small peduncles appear on thalli, bearing minute trimorphic or zygomorphic flowers with four anthers. As they mature they form dehiscent fruits. Seeds get dispersed with water and are left in the debris on the banks of streams. In Maharashtra they are found at Mahabaleshwar, Pratapgad, Harishchandragad, Tryambak, Karla, Bhaja near Lonavala, Rohideshwar etc. It is common in high hills in the South and in Sri Lanka, Assam, Meghalaya.

The family is well-known for its short span of life. There are 45 genera and 200 species of it in the world. 6 genera and 6 species of it occur in Maharashtra. They have been described by Vartak and Bhadbhade (1973) with illustrations. Embryology of the family has been worked out by Razi (1949, 1966). The species show discontinuous distribution being located only at place with high altitude and heavy rainfall. They form the basis of Willis' 'Age and Area hypothesis'. Wider the distribution greater the age and plants with small localised distribution turn endemic. They are considered to be more ancient.

Later Willis modified his views and propounded the theory of progressive and regressive endemism. An endemic species may begin to spread again or may tend to have more and more localized distribution. Both the processes are at work in nature and this point is discussed by Mahabale (1966, pp. 102-107). There is vast literature on Endemism, only selected literature on the family is given at the end of this topic.

Willis (1902) has sub-divided this family into the Podostemaceae and Tristichaceae.

Genus and species	Locality	Flowering period	Remarks
(1)	(2)	(3)	(4)
1. Terniola zeylanica (Garda) Tul.	Tryambak, Igatpuri Mt. Kalasubai, Harishchandragad Bhimashankar, Matheran, Lonavala, Bhaja, Karla, Rohide- shwar, Amboli ghat, Tinai ghat Dudsagar, North Kanara.	,	Also occurs in Ceylon on smoot- gnesis rocks in streams at Peradenya in Karna- tak State.
2. Terniola zeylanica var. Konkanensis (Willis) Sant			
3. Terniola zeylanica var. malabarica Willis.	Dudhsagar	Sept-Dec.	Karnatak State.
4. Dicraea stylosa Wight	Harishchandra gad Bhima- shankar, Lonavala, Mahabaleshwar.	Oct-Jan.	Madagascar, Sri Lanka, Tropical Africa.

5. Zeylanidium lichenoides Junnar, Lonavala, .. Sept-Oct. ..

Engler.

Mahabaleshwar.

(1)	(2)	(3)	(4)
This species has 2 varieties	es.		
var. 1 <i>Khandalensis</i> Willis.	Common at Khandala.	••	0 1 d
var. 2 <i>bhorensis</i> Willis.	Found in Bhorghat near Khandala.	***	61.0
6. Hydrobryopsis sessile Engler.	Dudhsagar.	Dec- Febru.	Karnatak State.
7. Griffithella hookeriana Warm.	Harishchandra- gad, Junnar, Pratapgad, Kon- kan, Atgaon.	•••	Also in Kala- Nadi (North Kanara), Karnatak State.
8. Podostemon subulatus Gardn.	Harishchandra- gad.	Aug Oct.	Sr Lanka, on rocks in the Mahaweli Ganga river.

Genus Podostemon occurs widely in Sri Lanka and in Assam (Meghalaya). It is not known from peninsular India. Except from a few places. सत्यमेव जयते

(c) Balanophoraceae:

The third peculiar family in Maharashtra is Balanophoraceae. It is a root parasite, growing on the roots of Carvia callosa, Carissa congesta. It was reported by Birdwood and Woodrow possibly occurring on Murraya paniculata Jaq. It was first located at Mahabaleshwar wood below the Dhobi's Fall by Mrs. W. E. Hart as early as 1885 and described by her in Volume 1: 75 of the Bombay Natural History Society's Journal. Later it was collected by Vartak on Carvia callosa at Ligmala Fall at Mahabaleshwar and at Khandala by Santapau (1941-1949), but it could be located again at Khandala. Blatter has described it elaborately in Bombay Natural History Society's Journal in 1929, Vol. 33-309 under the name Balanophora Indica Wall. as a new species.

The species is dioecious. It produces about 6-9" white stalks or peduncles with globular heads of male and female flowers. The ovules lie in long drawn out sheaths and look like Corpocephalia. There are no leaves, except during reproductive phase, otherwise it cannot be seen or recognized. It is equally common in woods below cascades at Kodaikanal and other places in South India.

Recently Vartak and Chitnis (1977, p. 155) have reported another species. Balanophora dioeca at Hivre in Dr. Alexander Gibson's Park and Botanical Garden, in Junnar taluka, in Pune district.

Besides Balanophora Indica the following plants also are root parasites. Their relationship with the host needs further study.

(d) Orobanchaceae:

- 1. Orobancheae gyptica Pers.—This is a pernicious pest on the roots of tobacco and jowar. It appears generally in winter.
- 2. Orobanche ceruna Loeft.—It is rather rare. The former is a scapagerous herb with pendant floral stalk, flowers purple coloured and seeds minute.
- 3. Aeginetia indica Linn.—It is a parasite on Strobilanthus and on Carvia callosa. It occurs at Rohideshwar and Panshet. It has tuberous rhizome and short coral-like roots.
- 4. Christisonia Lawii Wight and (5) Christiansonia calcarata—Both parasitise on Strobilanthes at Khandala, Lonavala, Thane, etc.
- 5. Cistanche tubulosea Wight.—It is a pretty looking parasite on roots and underground parts of Salvadora persica Ahmedabad. It has not been reported from any part of Maharashtra.

(e) Scrophulariaceae:

1. Striga sps.—There are six species of this parasite on grasses. They generally grow in pastures in rainy season. They are plenty in grasslands around Pune, Kolhapur, particularly 5 species Striga lutea and S. alba and Striga orobancheoides. It is quite common in grasslands in hilly parts at Khandala, Mahabaleshwar etc. Recently Dr. S. B. Kamble of B.S.I., Pune has found Alectra parasitica on the roots of Vitex nigundo in Akola District in Vidarbha.

2. TENTATIVE ANALYSIS OF MAHARASHTRA FLORA

The flora of British India written by Hooker now nearly hundred years back has estimated about 17,000 species of flowering plants belonging to 176 families. This estimate undoubtedly needs to be modified considerably after the revision undertaken by the Botanical Survey of India for the plants in the country. However it indicates broad outline of plant world in the sub-continent. Flora of the reconstituted Maharashtra also needs to be revised as many new species are added to it. The broad trends indicated by the analysis by Blatter (1908) of the flora of the erstwhile Bombay Presidency still holds, good as no new family is added by the addition of the new area to it.

The Botanical Survey of India was started by Dr. King in 1890 and he also initiated writing regionwise floras. The first regional flora of any State in India was the "Flora of the Bombay Presidency" by Dr. Theodore Cooke between 1901 and 1908.

In the "Flora of the Bombay Presidency" Cooke has described 2,530 species. The flowering plants in it belong to only 117 Orders. Of these 22 Orders on families have not more than 2 species, and 12 have only one specie.

The present position, however, is slightly different because of the researches of various taxonomists like Blatter, Mc Cann, Santapau, Vartak, Puri, etc. Members of the Botanical Survey of India have added

many more species to those described by Cooke. At present they are estimated as follows: The genera 838+4 new and species 1939+496 newly added. Cooke had enumerated only 117 families, but due to modern trend of splitting them into smaller families this number is estimated to be 133. The most important families in Maharashtra, in point of number of species and genera, are as follows:—

Serial No.	Fa ₁	nily				Species	Genera
(1)	(2)				(3)	(4)
1	Poaceae (Gramineae)					281	56
2	Papilionace					187	49
3	Cyperaceae					107	11
4	Acanthaceae					106	31
5	Asteraceae (Compositae)		errorre			102	47
6	Orchidaceae	ANS.	36/	2		94	24
7	Euphorbiaceae					89	30
8	Rubiaceae	(E)	â.,			68	29
9	Asclepiadaceae	() ()		#		59	24
10	Scrophulariaceae	14	¥ 88	X	••	59	24
11	Lamiaceae (Labiateae)			37		54	21

The total number of genera recorded by Cooke were 838. Later additions to Cooke's Flora made by others have increased the total number to 1,003 genera and 2,509 species. The new additions are 6 genera, and 848 species. There has not been addition to the number of families. Some of the families have very wide distribution, whereas others have comparatively very limited distribution.

These families may be compared with the dominant families with other parts in the country surrounding Maharashtra, namely, Karnatak, Malabar, Andhra Pradesh, Madhya Pradesh and Gujarat. The dominant families in Maharashtra are Graminae and Leguminoseae. They have the largest number of species and genera. They grow again during monsoons, and last till January. This is mainly because the whole of rain fall is only for a period of 4 months. Because of this the dominant families in different regions are different in ranking. This becomes evident from the Table on next page.

TABLE No, IX-A-2-1-SHOWING THE ORDER OF DOMINANCE OF 10 ANGIOSPERM FAMILIES

Family	<u>></u>		Flora of Khandala (Pocna district) as per Santapau (1957)		Flora of Junnar and surround- ings (Poona district)	Thana District Flora	Flora of Phonda- Amboli ghats (Ratnagiri district)	Flora of Goa	Cooke's Flora of the Presi- dency of Bombay	Gamble's Flora of Presidency of Madras	Hooker's Flora of British India	Flora of Agumba (Shimoga district, Mysore State)
(E)			(3)	62	(3)	(4)	(5)	(9)	(7)	(8)	6	(10)
Poaceae	:	;	.:		I		IV	AL WOOD	п	П	111	Ш
Fabaceae	;	;			ш	1000年100日	1		I	H	=	I
Asteraceae	;	:	::	_	H	H	À	IΛ	IV	ПΛ	VII	IA
Cyperaceae	;	;	> :) N	λ.	VIII	W	IA	VIII	VIII	>
Euphorbiaceae	;	;	: VI	_	>	>	П	Н	>	>	>	VII
Acanthaceae	;	;	IV	7	ΙΛ	VI	III	IA	Ш	Ι	IV	ΙΛ
Rubiaceae	;	:	XI ::	~	VIII	VII	VII	>	VII	Ш	Ι	II
Convolvulaceae J	;	:	× :		XI		X	ΙΙΛ	×	:	:	ПХ
Orchidaceae	:	:	:	:	:	VIII	:	:	:	:	1	:
Scrophulariaceae	:	:	[A ;	VIII	×	X	:	XIII	:	:	:	:
Lamiaceae	;	:	:: X	=	VII	×	VI	×	:	X	XI	ïX

3. DISTRIBUTION OF ANGIOSPERM FAMILIES IN MAHARASHTRA

The distribution of plants is primarily go verned by climate, secondarily by soil conditions and is further delimited by the biotic influence of plants and animals mutually. Among the climate the factors pertaining to rainfall, range of temperature and humidity, drought period and its ratio to the humid period are important. The varied topography of India having different soils makes difference in the distribution of species as they also are important factors in the spread of plants. In the spread of species it is not the intrinsic number of the seeds formed by a species, but the germination of their seeds and survival of the seedlings; their ability to stand in varied climate and soils, and their adaptability to microclimate that determines the rate of survival of seedlings. For example a large number of seeds are formed and fall at the edge of Sahyadris (plants like Memecylon umbellatum). Despite their enormous number of seeds, the number of plants that survive ultimately at different places in the ghats is very small. This is largely due to the fact that seeds get washed away from the edge down to the valleys and lower slopes. There they do germinate but are unable to face drought period and get dried up completely and often die in summer. It is only in those places where the debris of dried leaves and organic material and water are available for them to germinate, that the seedlings survive. Many species which do not stand high temperature or low temperature or frost gradually migrate from their original place to other more favourable places. The soils in India are derived from different types of rocks and their nature changes according to their origin. In Chandrapur and Bhandara districts, soils are sandy. Elsewhere they are of Deccan trap origin. They do not mature under identical conditions, nor are they formed at the same altitude or time. This makes them different in their rate of maturing. A characteristic type of soils of Deccan traps in Maharashtra is Black cotton or Regur soil. The problem of Regur soil has been already discussed elsewhere and need not be repeated here. These soils generally contain clay fraction in large amount. They do not have enough organic matter. They do not retain water and develop cracks due to their sticky nature. Water in them gets evaporated from the cracks formed, exposing thereby the underground parts of the plants. The second type of soils, are sandy or loamy. The latter are fertile but they do not contain all the ingredients necessary for the plant growth like black cotton soils. Their fibral nature, loose particles, allow the water to percolate quickly down from surface. The rain water spreads to roots and the growth of plants is better. The best growth of the trees especially is to be seen in the loamy or mixed soils of Chandrapur. In Bhandara and parts of Nagpur the soils are mixed. They are also good for plant growth. We shall therefore consider the distribution of some important families only.

The distribution of plants is said to be continuous, discontinuous, cosmopolitan, rare or endemic. All these kinds are to be found in the distribution of families and individual members among the plants of Maharashtra. But as a rule, no endemic family is found. This is mainly because the Maharashtra flora contains many plants from the surrounding areas and they grow mixed. There would hardly be a few species which are rare in the whole of flora. Not more than 200 species have been mentioned by Cooke as rare in Bombay Flora, but about two dozen only are endemic. The number of endemic species indicates the past history of the family, but what were considered to be rare, come to light sometimes from entirely different areas, and thus their rare character is lost. Such examples are not infrequent. Cooke's findings therefore

have to be taken with modification. The first ten families numerically superior to others are also common to South Gujarat and Madhya Pradesh, and Telangana in Andhra Pradesh, part of Northern Karnatak being contiguous. They indicate the relationship of the Maharashtra flora to that of the adjoining regions. However certain families have greater representation in Maharashtra than in other areas e.g. Gramineae. Some like Podostemonaceae are unique. The largest family in India is Orchidaceae but in Maharashtra Gramineae is number one. absence of a family also indicates only rarity; some indicate past history. For example the family Dipterocarpaceae. This family had large distribution in the past in Peninsular India, but now it is very restricted in distribution not only in Maharashtra but in the whole of Peninsular As a matter of fact, Dipterocarpus, Shorea, Anchistrocladus, Litsea are not found in the flora of Maharashtra, but they do occur in the flora of Madhya Pradesh and Karnatak. Madhya Pradesh has the largest number of Leguminosae in the country, but it is second in Maharashtra.

As examples of endemics Frerea indica, Iphigenia stellata, Senecio hewrensis, Seshagiria sahyadrica, Arisaema caudatum, Kalanchae bhidei, Dicanthium mccannii, Euphorbia erythrodata, some grasses, Ceropegia and Habenaria species may be cited as endemic.

The order of predominant families here is Gramineae and Leguminosae. They have different places in the surrounding States. Although this suggests that Maharashtra is rich in grasses, and that fodder for cattle should be abundant, but it is not really so because the edible grasses completely dry up soon after December. There is a great preponderance of perennials in Maharashtra nearly double the annuals and biennials. This accounts for the deficiency of grass partly. The number of trees constitute nearly double the number of herbaceous plants, but they also dry up in summer.

The proportion of monocots to dicots is 1:3·2 as against 1·2:2·7 in the whole of India. Monocots constitute 26 families as against 1·15 families of Dicotyladons. The larger genera undoubtedly are from the family Graminae such as Andropogon, Panicum, and in the dicotyladons Crotalaria and Indigofera. The ground orchid genus Habinaria is very large. The other larger genera are Hibiscus, Vitis, Ipomoea, Euphorbia, Ficus, Grewia, Impatiens, Acacia and Leucas.

Just as there are large families, there are also others which are very small or scarce. Among these there are some which are tending to wards endemism. Blatter (1908) has found 127 endemic species in Bombay Presidency of which 55 belong to monocot and 72 to dicotlydons. However, with further knowledge of the distribution of the different species and families, this number is bound to be changed.

Nearly 1/7th of the species are climbing. They belong to the families Legumin oseae, Con voloulaceae, Asclepiadaceae, Cucucibitaceae, Vitaceae, Menispermaceae, Apocyanaceae, Celastraceae, Oleacaeae. 1/3rd of these are woody. The giant among them is a woody species found in Dev Raies, Entada pursaetha which has the largest dicot seeds in practically the whole of plant kingdom and has also huge pods. It is a liana which climbs on tree tops in evergreen and semi-evergreen forests in Konkan, Khandala and in the Ghat region. There are 40 parasitic plants, the important of which are Aginetia indicago wing in the midst of clumps of Euphorbia refifolia, Chrastisonia lawii, C, calcarata growing on the roots of Karvi, Carvia callas.

Recently Dr. S. B. Kamble has reported a new root parasite on the roots of Vitex negundo in Akola district, Alectra thomsonii and Alectra indica (parasitica) (family Scrophularaceae). They grow on the roots of Vitex nigunda. Cistanche tubulosa of the same family grows on the roots of Salvadora persica. Various species of Orobanche, one of which is a parasite on the roots of tobacco and jowar, and is a bad weed, also Striga orobanchioides. Balanophora indica growing on the roots of Karvi (Carvia Callosa) is found at Mahabaleshwar, and B. dioceae at Hiwre (Dist. Pune). These are complete parasites. They are not green like Cuscuta sps. or semi-parasite like Cassytha, species of Loranthacea such as Scurrula, Taxillus, etc. There are not many epiphytes in Maharashtra except in high rainfall region adjoining Sahyadris such as Remusatia vivipara, orchids like Dendrobium, Acampe, Aerides, Eria species. A few ferns Leucoustegia pulcra, Pleopeltis membranacea, Niphobolus sps. are seen in semi-evergreen forests and in Deo Raies.

Many monocots belonging to Zingibera Ceae, Liliaceae, Musaceae. Asclepiadaceae form underground tubers—with the help of which they perennate. These plants are important in maintaining the soil cover on the high crest flats of Sahyadris and on the mountain tops. There are a number of Saprophytic plants especially some orchids. Without association with fungus ground orchids are unable to grow in soil. As regards the insecticide plants, there are only a few. The genus Utricularia is a well known aquatic plant having some marshy species also. They trap insects in utricles and digest them. There are three principal types of utricles. Utricularia stellata is a floating a quatic species which produces four floats in the midst of which the long scale comes out. They balance the plant on surface of water e.g. in Vihar Lake, Bombay. Other species produce root utricles e. g. Utricularia striatula growing at Panchgani, Khandala, etc. They produce traps on the leaves. All these species have to be fully investigated. The other insectivorous genus is Drosera. Two species of it are found in high rainfall region; one in marshy places such as Khandala. They have large sticky tentacles on leaves by means of which they produce shining traps; they mislead and capture insects. Drosera burmanni is a flat species with rosette of red leaves and Drosera indica grows erect. Both the species are occasionally found in Bababudan hills in Karanatak. D. indica occurs at Khandala.

On the whole, the flora of Maharashtra for the greater part is well represented by dry deciduous species in the forests. It represents climatic climax. It is difficult to imagine that any other type of vegetation could have subsisted under the conditions of plant life here. Since the beginning of Tertiary period the greater part of it soon after the Deccan traps were formed in Eocene they are a constant feature of its flora. The soils derived from them have been the same but are matured at different periods. The rainfall pattern has been nearly similar, but there have been a few fluctuations in the climate throughout the course of the Tertiary period. The topography has remained more or less unchanged. There has been very little length-wise movement of Sahyadri except turning slightly to the east in Khandesh and Dangs but even that has been more or less the same. Therefore the conditions of plant life here are fairly constant. Occasionally there have been some variations but not so significant as to completely overhaul the pattern of the plant life.

This appears to have been so even in the past since post-Neogene period. Although the Deccan traps were poured on different terrain the conditions of geomorphology have been nearly similar. There

must have been large areas occupied by deciduous forests, most of them dry, and in some pockets moist. It is well-known that this type of vegetation is dominated by Tectona grandis, Adina cordifolia, Anogeissus latifolia community of plants. Hence throughout Western Maharashtra, Marathwada, Wardha, Nagpur, Bhandara and Chandrapur area we get dry deciduous forests. However, there are a few isolated patches where we find semi-evergreen or evergreen forests as the principal type. The semi-evergreen forests are seen mostly on the Desh side, especially where the rainfall is more than 60", near the edge of Sahyadris as in These Mawals are peculiar to the Desh. They are formed by the lateral spurs of Sahyadris or their branches. They isolate the flora from one another. Rivers rising from the main Sahyadri ranges and flowing eastwards give rise to more or less uniform climate on account of which the same type of forests and flora prevail. Isolation from each other makes them contain some plants which are localised and even endemic. The situation on the Kon kan side is a little different. There at the foot of the Sahyadris, there is Tarai-like region and pockets of rich forests dominated by tropical trees, somewhat like that of Tarai at the foot of Himalayas. These also like semi-evergreen forests on Desh side are isolated. They never form a continuous stretch of the vegetational belt. Beyond them away from the main range there are also small strips of deciduous forests and then mangrove forests preceded by strand plants towards sea coast. On the crest of Sahyadris there are pockets of evergreen patches of forests in the valleys, but they again are isolated from each other. They generally contain the tropical as well as a few temperate elements. The temperate elements are confined to the high mountain tops; the tropical elements are spread in the high humidity areas. The rest of the area has on ly the dry deciduous forests.

The rains in most of the dry areas are about 380 m.n—760 mm. There are a few places where the rainfall is 1000 mm—1270 mm per annum. After October there is drought for nearly 8 months during which the herbaceous flora dries up. During the rainy season there are many large areas where good pastures or open grasslands occur. Thus the vegetation succession appears to be:

Evergreen forests,
Semi-evergreen forests,
Deciduous forests (moist and dry),
Scrub,
Grasslands.

This is, in brief, the picture of the vegetation of Maharashtra. It has remained nearly the same since the late Eiocene period.

As regards the various elements in Maharashtra flora, it has been noticed that they are mostly the south subtropical. A few temperate elements are there but they are of a secondary succession. The list of surviving Eiocene period plants is small. The great majority of plants at present are of the post-Miocene period. The Miocene species were nearly the same as now. Therefore most of our flora is of the Miocene and post-Miocene period. The second important peak of the volcanic activity after Eiocene was during Tertiary period. Some climatic fluctuations were there in Pleistocene, Glacial periods, but they have not much affected the Maharashtra area. We have very few places where we get the Placocene plants. On the river banks in a few places like Sangamner we find a complete succession of the flora. This succession

has led mostly to the dry deciduous trees and grasslands. A large number of plants found in the Quaternary are a mixture of dry and a few temperate species. But the temperate genera such as *Podocarpus*, *Salix* have disappeared. They are succeeded by dry deciduous species. This is seen in succession right from the basal most part on the traps at places in Konkan and on the Desh side. There are a number of animal remains in the archaeological horizons on the banks of rivers in Maharashtra. These are largely herbivorous animals and only a few carnivorous. To support herbivorous animals like elephant, goat, bullock there must have been large pasture lands and bushes than today, under which they could take shelter. This is seen from the study of archaeological plants and animals.

Regarding the elements that constituted the Maharashtra flora, it was noted that in addition to some original ones, some have come from surrounding areas, except perhaps from the desert region of Rajasthan. But all other regions such as Indo-Ganga planes, Malabar, East Assam have contributed to the composition of the flora in Maharashtra. There are, however, quite a few endemic species in Maharashtra, mostly belonging to the families Gramineae, Asclepidaceae, Legimunaceae, Compositeae, Rubiaceae, Musaceae. The number of rare and endemic species can be counted from Cooke's account of the flora of Bombay. about 200 species. Of course, this will change as our knowledge of the distribution of the species will increase. All the same quite a substantial part of it will remain intact. On the other hand, new endemic grasses. species of Ceropegia, Phoenix have been brought to light by the efforts of the different workers such as Blatter and McCann and the members of the Botanical Survey of India in the Western Circle. This shows that there has been some original flora in Maharashtra to which the elements from the surrounding areas were added; but only a small proportion of the original flora has remained here. It has also been ascertained that the post-Miocene plants from Andhra Pradesh, where also the Deccan traps occur have migrated westwards and southwards and have been added to the flora of Maharashtra. Thus the flora of Maharashtra today is somewhat different and is a composite flora wherein plants of adjoining regions have found suitable environment for their growth. deciduous forests and dominant elements in them have changed but the general type has remained the same. The dry deciduous forests have arisen from the moist deciduous forests and from the evergreen or semievergreen forests. Ultimately they have resulted in scrub due to nature of the soil derived from traps in several places, and the subsequent soil erosion.

Thus it appears that the flora in Maharashtra is only slightly altered in course of long time. At no time it had continuous evergreen forests but only as isolated entities. Though the flora has not altered much, the composition, density and size of dominant trees have altered. The lofty Tectona grandis forests of Chandrapur represent that. They have been replaced by small sized stunted Tectona grandis trees in the present deciduous forests of Desh.

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B. CONSIDERATIONS OF ECONOMICALLY IMPORTANT PLANTS

स्यमन ज

4. CULTIVATED PLANTS AND THEIR WILD PARENTS

Many cultivated plants are grown all over the world, They are derived from some wild ancestors of them found in natural surroundings. Most of the crop plants are thus derived, for example, wheat grows wild in Palestine, bajari in Africa and in India, coconut in Malaysia, Polynasian islands and India. Citrus fruits have their parents in wild species growing in Assam and north-west Africa. Origin of maize, though highly controversial, is probably in South America, of Cajanns in Western Ghats. Several species of rose grow wild in Himalayas, but they are not so ornamental as the culitivated ones. The widely cultivated grape vine (Vitis vinifera) has its origin in wild species of Vitis. But during its long cultivation by man, many of the cultivated plants have changed their character, especially those which are useful to man. In cultivation, however, they have become less resistant and susceptible to many plant diseases. Their fruit qualities and seed qualities are improved considerably by the repeated cultivation and selection by man, but their resistance capacity is not improved to the same extent. Similarly man being primarily interested in seedless fruits, he prefers parthenogenetically produced fruits, and species that propagate vegitatively to preserve the same characters as he wants and are founde useful in the species. Repeated hybridisation is also responsible for improvement in the performance and certain qualities. It however leads to deterioration in its reproductive capacities. Vegetative reproduction also results in some plants almost forgetting the normal way of sexual reproduction

Thus, many cultivated vegetable species are propagated mainly vegetatively. Potato, the original home of which is in America's East Mountains, and sweet potato, are examples. In Maharashtra also there are some wild plants which are the parents of the cultivated plants. Many species of Vitis are found wide ranging from highly woody ones like Vitis repanda to those that are very small and fleshy like Vitis trifolia. There are also xerophytic species like Vitis quandrangularis, but not all these are useful in the breeding work. The main purpose of crossing the cultivated species with their wild parents is to see how far the disease resistivity and reproductive capacity of the species would be increased, and how far they give the different types-cultivars that could be separately cultivated later. It is only by hybridisation and selection that the better varieties have been produced for most of the crop plants, cereals, fruits and vegetables. The process, however, has not been much used in forestry. This has resulted in not finding better varieties or more useful tree strains suitable for different regions of India today. The following list gives the important cultivated plants, their original home and wild parents. The specific criterion for determining the relationship of the wild species of a genus with the cultivated species is their ability to intercross and breed and produce a number of fertile types. This has been shown to be so in the case of Cajanus cajan and species of Tylosia growing wild in the hilly regions of Maharashtra. A number of crosses have been obtained, but very often not all crosses are economically useful. In a similar way, it is shown that various varieties of wheat that are cultivated today, both summer and winter varieties contain resistant genes of Aegiolops (Chennaveeraiah, 1964). This list will clearly show a wide choice for hybridisation and for getting back the resistance from the original parents by genetic work. But not much use of it has been made on a large scale. There is a wild citrus fruit growing in the midst of semi-evergreen forest known as Atata racemosa. It produces wild lemons quite bitter in taste but containing lot of juice and having lot of resistivity. About the cucurbits quite a number of them have been evolved and the varieties have been really made constant or fixed by usual processes of genetic fixation. But in agricultural and horticultural practice, it is the maintenance of the same variety or the same species or even the race which is of utmost importance to get the same quality of the fruit, seed or other parts. But sometimes in cross breeding one gets a better variety also. For example, a cross has been effected between Anona squamosa and Anona reticulata. This cross is so successful and produces fruits which are sweeter than Anona squamosa. The seeds are small and few, and the pulp is more as in the case of Anona reticulata. It would be worth while crossing other species of Anona also, and see what kind of fruits one can obtain.

The real difficulty comes in when one finds hundreds of varieties, and yet have the same chromosome numbers suggesting, as if they have the same genetic constitution. Mango is an example of this. All the species of mango including the Malaysian or the African species possess the same number of chromosomes in all of them 13. Wild mangoes are a rarity. The sour fruits they produce are so small and contain such a large stone that they are not very useful for eating. A similar story is that of Areca or the betelnut. Its wild parents are supposed to have been in the hills of Malabar, but no definite conclusions can be drawn about this. Just as the wild mango which is found in the Western Ghats of Sahyadris, especially in North Kanara and Sindhudurg district, we cannot say that all the cultivated varieties of Areca or mango have been derived from them. A repository and nursery of wild plants of the State is highly desirable.

All the cultivated crops, fruit trees, garden plants and medicinal plants are international, because they have been transported from place to place by man. Right from the days of horseman of Steppes in USSR man has taken the seeds or the fruits from his own native country to a new country. Sometimes it is the new country where they prosper better than in the original country. Guava, which is supposed to be of South American origin grows very well in India, rather than in many other places. Brinjal which is native of India, produces very small fruits. But numerous varieties of it have been developed and cultivated in all parts of the world today.

Hybridisation of ornamental plants is practised by nursery men and seedsmen all over the world on a large scale. They also bring wild varieties, grow them in their gardens and green houses and improve their ornamental qualities. Most of the cultivated ornamental flowers have their wild parents. In natural conditions all wild plants produce various types and mutants. It is by these natural processes and selection, that several species of Artemissia and Chrysanthemum have come into existence and they are distributed over various areas where they prosper and find suitable habitats. They again multiply on large scale and select new strains. This process has been going on throughout the course of evolution.

It is also known that by tissue culture, orchids are commercially grown in Singapore and in Malaya and sent abroad all over for their beauty and fragrance. The average gardner in India has not learnt this new technique to bring forth new ornamental varieties. The common economic plants, their original home and the time since they are being cultivated are shown below:—

Name	T.	Native home	Culture
Wheat (Triticum sativum)		Mesopotamia, Palestine	Prehistoric
Barley (Hordum sativum)	154	West Asia	Do.
Rice (Oryza sativa)		South-Central and South-East Asia	
Maize or Indian corn (Zea mays)	10	Central America, South America	Do.
Buckwheat (Fagopyrum esculentum)		Manchuria, C. Siberia	Modern
Walnut (Juglans regia)	••	E. Temperate Europe, Temperate Asia	Ancient
Almond (Prunus amygdalus)		Mediterranean basin, W. Temp. Asia	Prehistoric
Peanut (Arachis hypogea)		Brazil	Ancient
Coconut (Cocos nucifera)		India, Polynesia	Prehistoric
Kidney Bean (Phaseolus vulgaris)		South America	Do.
Lima Bean (Phaseolus lunatus))	Brazil	Ancient
Common pea (Pisum sativum)	٠.	South-West Asia	Do.
Be t (Beta vulgaris)	•	Mediterranean basin S. W. Asia	Do.

Name	Native home	Culture
Radish (Raphanus sativus)	Temperate Asia	Anci€nt
Turnip (Brassica rapens)	Europe, W. Siberia	Prehistoric
Carrot (Daucus carota)	Europe, W. Temp. Asia	Ancient
Sweet potato (Ipomoea batatas)	Central America	Prehistoric
Onion (Allium cepa)	Persia, S. W. Asia	Do.
Asparagus (Asparagus)	Europe, W. Temp. Asia	Ancient
Cabbage Kale (Brassica oleracea)	Europe	Prehistoric
Spinach (Spinacea oleracea)	Persia	Ancient
Cucumber (Cucumis sativus)	India	Prehistoric
Pumpkin, Gourd etc (Cucurbita pepo):	North and South America	Ancient
Turban squash (Cucurbita)	South and North America	Do.
Sugarcane (Saccharum of cinarum)	India	Do.

5. FRUITS AND FRUIT CULTURE IN MAHARASHTRA

Many fruits are grown in certain areas of Maharashtra, though not on a very large scale.

Fruits are generally classified as temperate and tropical fruits. Those which grow in temperate countries generally have less starch and more of acid, pulp or juice. Due to cold climate they do not ripen quickly, nor co they get rotten easily. The tropical fruits, on the other hand, contain large proportion of starch, sugar and pigments and they ripen quickly. Therefore, preservation of tropical fruits is not so easy as in the case of temperate fruits. In most of the countries there are huge refrigerator plants and they are used for preserving fruit. But this is not yet the case in India, Mango in Konkan ripen so quickly that quite an amount of fruit gets waste. In Nagpur where the citrus plantation is on a large scale they get easily spoiled for want of cold storage facilities. The same is true of strawberries at Mahabaleshwar and Panchgani.

Botanically a fruit is a ripened or modified ovary. It serves the purpose of storing the food material for seeds, and for their dispersal. This dual purpose of fruit is achieved in various ways in different fruits and consequently the edible parts are also different in them. Majority of the fruits have seeds, but attempts are being made to produce seedless fruits. Seedless fruits are obtained by parthenogenesis. As a matter of fact the world's best fruits are parthenogenetically produced.

Temperate fruits:

Since Maharashtra lies a little below the Tropic of Cancer, we do not have much cultivation of temperate fruits except in the hilly regions ruch as Mahabaleshwar and Panchgani. Commonly cultivated temperate ruits are: various kinds of berries such as strawberry, gooseberry, asp or rose berries and mulberry.

Strawberry.—This is largely cultivated in well manured soils at Panchgani and Mahabaleshwar, but more at Panchgani, because the plant does not tolerate much of rain and needs good drained terrain for its growth. The species cultivated generally is Fragaria chinenis. It is propagated vegetatively at the end of the rainy season. It produces many suckers during winter and begins to flower in February. The fruits are ripened by March when they are available in market. Practically the entire fruit of strawberry is marketed direct to Bombay, as the delicate fruit has very poor keeping quality, and there are no large scale refrigerators for its cold storage.

Gooseberry.—Another fruit commonly cultivated in hills is gooseberry *Physalis maxima*. It keeps well if not attacked by fungi because of the dry marcescent calyx. It is a delicious fruit very much liked and not very costly compared to strawberries. It comes mostly from Panchgani in the markets of Pune and Bombay.

Rapsberry or Roseberry.—This grows practically wild in Mahabale-shwar and hilly Pune area. During summer it produces small red fruits on tall creeping branches of roseberry plants looking almost like wild rose. There is not much cultivation nor market for it. So it is mostly used for preparation of jams.

Mulberry.—It is a collective fruit, grown in various areas, particularly where humidity is high in winter and early summer. The trouble with the plant however is that it has the highest number of varieties (about 250) and therefore, a known good yielding variety has to be maintained by vegetative propagation. There are two main varieties of mulberries, those which produce purple black reddish fruit, and those which produce long greenish fruits. Long greenish fruits are not much cultivated in Maharashtra, but more in the fruit producing area of Palanpur in Gujarat. This variety is tasty and sweeter compared to red fruited one, which is sour to begin with. Therefore, large scale cultivation of this plant is seen only in Mahabaleshwar, Dahanu, Kosbad area. It is cultivated in gardens elsewhere, but is not very popular. It is eaten as a dessert or used for preparing jams. Silk worms are grown on its leaves.

Grapes.—Another temperate fruit is grape. The culture of grapes is very popular in many parts of Maharashtra State. It was largely cultivated previously in Nasik area but the cultivation has now spread to other parts, such as Chikhali, Baramati, Pune, Neera, Sangamner, Tasgaon, Phaltan, Khuldabad where good grapes are produced. The grape vine Vitis vinifera is a good host for numerous diseases. The plant needs special methods of prunning and culture to get fruit in plenty.

Generally only one season—'spring', is used for collecting good fruit commercially. More than 250 varieties of different kinds collected from Afganisthan, Middle East, Russia, Iran, Spain, France, America and other grape producing countries are grown, depending upon the taste of the people and the suitability of season for the production of fruit. The grapes rot easily and also ripen quickly due to summer heat.

The popular varieties are *Bhokri* or Bukhari from the city of Bukhara in Uzbekistan, large variety of Anabeshahi, Selection-7, seedless Thomson and small *Kabul* variety of Chaman. By experience it has been found that if a variety such as *Anabeshahi* which has good fruits and heavy bearing is treated with gibberalic acid, the fruit becomes large and bearing also improves but loses taste as the sugar percentage goes down. Two

other popular varieties are Kali Sahebi and Cheema Sahebi. They have long oval fruit. They are also a good bearer. From the viewpoint of better flavour Gulabi is a good variety. It is cultivated only in a few places because it is not a heavy bearer. Its production is mostly confined to Chikhali area in Vidarbha, Pune and a few other places. Once the cultivation of grapes was very popular in Baramati area where the yield was highest in the world. But the plants having had many diseases the orchards got diseased and had to be cut down, and sugarcane grown instead. However, due to popularity and nearness to town, the grapes are still in demand and get good price. Older varieties like Bukhari or Kandahari or Bangalore Purple are not in demand much, though they produce good crop, but are not so tasty as other new varieties. The essence of grape culture lies in proper prunning and feeding vines from time to time and keeping them disease free.

Among the other temperate fruits, apples, cherries, pears, squince are important, but their culture is nowhere practised in Maharashtra, though there are a few stray plants. Dr. Lush had tried culturing apples and pears at Dapodi near Pune in the East India Shipping Company Botanical Garden. The other fruits like apricot, plums have never been cultivated in Maharashtra as the climate and the seasons are not suitable for them. The other fruits which tolerate warm temperature climate are water-melons. They are mostly cultivated in sand and debris along the banks of large rivers where the manure in the form of debris get accumula-The large long stripped or oval varieties are not cultivated as in Karnatak State. Several commercial firms supply seed, but the hybrid varieties which have the flesh red right upto core from rind are more popular. The other melons cultivated are fleshy Musk-melon or Kharbuj. These also have several varieties cultivated in different places along the river banks or in sandy beds, but the two best varieties used as table dessert are the Kajla grown on the rich alluvium at Sangam at Allahabad. and yellow fleshed varieties so commonly grown on the banks of Gomati at Lucknow and Banaras. The white fleshy varieties which are rich in sugary flesh called Sarda are not cultivated. Many varieties of cucumbers are cultivated, and they grow well. Some of them grow in rainy season in Mawal region and have good keeping qualities, but it has green or yellow thick skin. Some varieties do not keep well being highly watery. However, wherever they grow they grow in abundance in the early summer season, but have no good preservation qualities.

Tropical Fruits:

Maharashtra being in sub-tropics, many tropical fruits grow well here, the most important of themare citrus fruits, mango, papaya and collective fruits like jackfruit, pineapple, custard apples, besides bananas, figs and miscellaneous fruits such as pomegranate, coconut and arecanut, bor, (jujube), lichi, guava, sapota, ambada, butter fruit (Persia gratissima) etc. Of these mango, banana, coconut, oranges, limes and lemons are important.

Coconuts are largely cultivated in orchards near the sea coast from Wapi down to Goa and further down in Malabar. The usual variety cultivated is tall but slow growing. It yields fruits not earlier than 8 to 10 years, but once started bearing it continues to bear for nearly 50 years. There are many varieties of coconut grown in different parts of our country. The large centres are Konkan, Karnatak, Malabar, Cochin and Puri. The production of areca-nut is not well organised as that of

coconut. Areca and coconut research is carried out at the Plantation Crop Research Station at Kasargod. They have produced some hybrid varieties of coconut which bear fruit earlier. They are short. They go in the market under the name Singapore varieties. A giant variety of coconut called Andaman or Ceylon giant is also cultivated but not commonly. The copra from coconut is required for oil and hydrogenated oil, but is not sufficient for purpose other than edible oil, Therefore they are largely imported from Andamans, Sri Lanka (Ceylon), Malaya, Singapore and such tropical islands as Maldive or Lakshadweep.

There is a controversy as to the origin of coconut, the South American genera related to coconut are small seeded species having fruits of the size of cherries, whereas coconuts in eastern countries have large fruits of Cocos nucifera. The origin of the areca-nut, is generally believed to be Indo-Malayan. Betel-nut grown on west coast of India, Assam, and is also imported like coconut. Coconut is believed to have come to India from Malaysia. According to Mahabale (1978) it is indigenous.

Citrus Fruits:

Citrus groups of fruits are cultivated best in Nagpur area where Tangerine like small oranges, as well as large oranges are cultivated on a large scale. Collection comes to Nagpur from surrounding areas and stored open in huge mounds like small hillocks and immediately auctioned. For want of cold-storage facilities, they are not preserved and many of them get spoiled in the process of transport. Some of the trading companies, therefore, prefer to extract citrus juice at Nagpur proper and then take it to their factories to process further for selling as orange juice.

The other area where citrus culture was common is Rahuri-Belapur area in Ahmednagar district, but due to Dieback disease on a very large scale most of the orchards have been cut down. It is also cultivated on relatively smaller scale round about Pune, but the climate of Nagpur which has both cold winter and warm spring, provides enough time to ripen the oranges slowly. Nagpur is supposed to be the best for the orange culture. Other fruits of this group are lemon and limes. Limes are cultivated in the gardens in a number of places around Rahuri, Pune, Aurangabad and Jalgaon, but on a small scale. There is no large scale production of limes in the State as in Uttar Pradesh, Punjab, Assam or Kadappa where cold is sufficient to increase their size and slow down the ripening. Lemons need early cold and hot climate later. Such climate is available around Ahmednagar, Pune and Jalgaon. At Nagpur, apart from suitable climate, alkaline soils containing lime are favourable. Lemon culture is not done on a large scale in Maharashtra State. When there is not much produce, they are imported from Gujarat, Mysore and Andhra and Madras.

Papaya cultivation is very popular in the basin of Tapi river in Jalgaon district. Many varieties of papaya are available. The Papaya development society at Lucknow has been working on them and spreading many interesting varieties. Most of them have flesh or pulp with orange colour. The giant varieties reaching the size of a round pumpkin are generally not cultivated because they are not tasty. Varieties from Singapore and Malaya have pink or deep orange flesh. They are also not cultivated. Cultivation of papaya is made for two purposes, one to get the fruit and the other to get papain. After the fruit has developed to a fairly large size and is rather raw and has not started ripening, incisions are made in the

skin or fruit wall. The latex comes out and gets dried on the fruit itself. It is scrapped off more than 2-3 times, dissolved in alcohol and crystallised into powder and sold in the market. It fetches good price. This is an industry in Jalgaon district near Jalgaon and Bhusaval.

A few collective fruits such as Jackfruit are not cultivated on a large scale. Stray trees are grown in hilly areas and also in the plains. They fetch good price. The cooking species of *Ficus*, *F. incisa* is rarely grown but not the other small fruited varieties which are so popular as vegetable in Uttar Pradesh. Another collective fruit is Pineapple. Pineapple cultivation requires well drained soil. In hilly areas of Ajra in Kolhapur it has been newly introduced and it produces good fruit but not yet on a large commercial scale as in Assam. Elsewhere it is not grown.

The custard apple has four different kinds of fruit. Anona squamosa or Sitaphal also called Sharifa. This grows wild generally in the hedges and on waste lands. The fruit is collected in October locally, but plantation on a large scale is done only at Khuldabad and around Aurangabad. Varieties with yellowish eyes and reddish eyes have been developed at Mehbubnagar near Hyderabad on Agriculture College farm and they are also introduced elsewhere. A cross between Anona squamosa and Anona cherimolia was effected at the Fruit Research Station-Ganeshkhinc, Pune, and its fruit is now available in the market. Anona muricata is grown only in Bombay area. It has very large fruit but is not very popular. Annona reticulata (Bullock's heart) is grown as a stray tree in a number of places, but large sized fruits come only from the humid areas around Nasik, Aurangabad and Pune. The culture of pomegranates is done at Rahuri on Mahatma Phule Krishi Vidyapeeth farms and in Saswad taluka of Pune. The usual varieties are not the same but are imported. Those with pink or white grains are quite sweet but do not have large size of fruit.

Fig or Ficus carrica.—Fig is a typical tropical fruit but its cultivation is done only in the Pune area in Jejuri, Welhe, Khed, Shivapur and Saswad. The plant is very susceptible to several fungal diseases and, therefore, its cultivation is not everywhere successful. For its fruit production and ripening, vectors carrying pollen are necessary and only one particular variety has become stabilised in this area. It was imported from Iran and the Gulf countries. However, the most tasty and sweet variety used for drying purpose, namely Smarna fig variety or the Spanish purple black varieties are not grown in Pune. There is a green coloured fruit variety rarely available in Maharashtra and to some extent at Dharwar and Bangalore, but that is also not cultivated, probably due to the lack of vectors. This fig does not produce fruits of the proper size in Maharashtra.

Bananas.—Banana culture is an important industry in Jalgaon district. The largest centres of banana production are Raver, Yawal, Bhusawal, Jamner and Jalgaon talukas. As a matter of fact, about 60 per cent of the requirements of banana of the upcountry cities like Delhi, Lucknow, Chandigarh and cities like Bombay, Nasik or Pune in Maharashtra are met by the fruit that comes from Bhusaval. The fruit ripens quickly and has to be exported in good condition to distant places. If kept longer, it gets spoiled. There is no systematic work on the preservation, cold or otherwise, of bananas as that of Wardlaw on the Jamaican bananas sent to England. This fruit is exported to the Arabian countries where it is popular. The usual variety which is grown in Raver, Yawal and Bhusawal area is known as Basarai. This is a Cavendish banana

and a number of varieties and strains of it are available, the most popular ones being those with yellow and green rind, and those which develop spots on them during ripening. This is known as *Chitrasal*, mostly cultivated in Surat and Navapur area. The traditional difference between the banana and plantain is the colour of the rind; when green they are called banana and those having yellow rind are known as plantains.

Another area where banana culture is successful is Vasai near Bombay. Gray in his Botany of Bombay Presidency (1885) mentions several varieties which were grown at Vasai in the past, but many of them have now died or discontinued, because they developed Bunchy top and other diseases which killed them. Others were killed by the attack of viruses and root fungi. Still the most successful variety at Vasai, Rajeli is being cultivated and has much demand. This variety produces less fruit compared to Basarai, and therefore is not very popular with cultivators. But it has good keeping qualities. They dry its fruit by very ordinary method of exposing to Sun drying, and then is sold in the market as Sukeli, or at times it is sold in powdered form.

The cooking varieties of banana are popular in the countryside. They are grown as stray plants in gardens. However, they are not grown on a large scale, nor are they used in every day use in meals as vegetable as in Andhra Pradesh or Tamil Nadu. As many as 122 varieties of bananas have been enumerated in Tamil Nadu, and there are also several good varieties in Mysore. One of the small fruited variety is known as Rasabale in Karnatak, another is called Sahasrabale in Gokak area, and a still other is called Muttubale in Kodaikanal hilly area. They all are practically hill banana varieties. Other banana products like banana powder are unknown in our State, because there is no banana research station anywhere in the State. There is a great possibility of increasing the banana production in the State but that needs well planned efforts and scientific study and market research. Certain varieties of bananas are easily made into powder which is a very nutritious food. A factory for producing powder of banana was started at Jalgaon, but due to local difficulties among the organisers, it was not a success. It is practically not functioning. There is no other place where there has been any factory for this purpose or research laboratory for banana research.

Like Rasabale of Mysore, a good table variety of banana in Maharashtra is Sonkeli or Apple banana. It is sweet, has good flavour and fragrance and also keeps long. Its cultivation is also very limited.

Grape fruit.—Grape fruit is a special variety of lime which produces fruits in bunches as in a grape bunch. It is highly nutritious and is much valued for its juice. The juice is slightly bitter and unless a taste is cultivated for it, it is generally not liked. Therefore, there are no orchards of this fruit as in America or Malaya, where it is cultivated on a large scale and juice is preserved for breakfast to begin with. Cultivation of this fruit is done at Anand in Gujarat. Stray plants are grown at Rahuri and in gardens around Pune and marketed in cities.

Mango.—By far the most important fruit of India is mango. There are innumerable varieties of this fruit throughout India. Most of them are derived from the same species Mangifera indica. The fruit is of variable size, shape, colour, flavour, aroma and pigments in the rind and pulp. The commonly cultivated and most popular variety Alphonso

needs humidity and heat for its good growth and ripening. Therefore, it is best grown in Konkan, especially in Ratnagiri, Devgad, Jaygad area. It is both exported abroad, and sent to Bombay and other places like Kolhapur, Delhi etc. Other variety which is equally popular is Payari. This has slightly thicker rind and its keeping quality is not so good as that of Alphonso. But its merit lies in its ability to grow anywhere on the Desh. In South Konkan, Goa, Dharwar and North Kanara this variety grows best due to suitable soil and climate favourable for ripening in season. The various varieties of mango have not yet been chemically or botanically well studied and fully classified. The analysis of some varieties was made by Dr. D. L. Sahasrabudhe. The mangoes in Bengal have been classified after fully studying by Mukherjee (1947). A scheme to do a similar work on Mango was initiated by Prof. S. P. Agarkar, but he was unable to complete it due to illness.

Broadly speaking, there are three kinds of varieties. The first variety e.g. Alphonso, ripens early, and fruits are brought into Bombay It continues to be much in demand for a long time. The same plant grown in Dahanu, Balsad region has more sweetish taste and is a little larger in size but has thicker rind than that of the fruit from Konkan. But the late ripening of Balsad Alphonso mangoes is helpful for price. After the Konkan Alphonso ceases to be transported to Bombay from Konkan due to monsoons, the Gujarat Alphonso fruit of Balsad, comes in Bombay market and fetches good price. Among the late varieties may be mentioned the varieties of North India such as Dashahari, Langda, Rajapur and the South Indian varieties such as Totapuri, Neelam, Benshan etc. They ripen right upto August and are available in the market, but still they are not so late as Shravaniya, the Punjab variety. Most of the upcountry varieties ripen late e. g. Shravaniya of Puniab. Their juice contains a high percentage of pectins. Some of the fruit from Andhra Pradesh especially early varieties like Baiganpalli come to Nagpur and Sholapur and other districts adjoining Telangana quite early, but these varieties are not available much, nor are they popular. In between these two late and early varieties, the country mangoes grown everywhere in every village, come in the market especially after one or two summer showers. They ripen very quickly due to heat and have to be consumed immediately. Patur in Vidarbha, and Kanhur. Kotul in Ahmednagar district are famous for good country mangoes: in Sangli district Kadegaon and Khed Shivapur in Pune district are also famous for mango. Their keeping quality is rather poor. However, in the Ghats and in certain hilly areas there are wild mango trees which produce late fruits upto August, but they never ripen. These are generally consumed for the sake of preparing pickles.

Now-a-days some fruit of mango is exported to England, Russia and other countries mostly from Bombay. All the mangoes that are greenish yellow in different regions have their separate flavour. There is a vast field for mango culture, but unless a special effort is made for research in methods of preservation, refrigeration and facilities for export, it may not be possible to increase the yield. Mango fruit ripens rather quickly. Some companies have their own pulp extracting plants and other equipment in mobile vans and they carry it to Ratnagiri and other places. There they extract juice and bring to Bombay for further processing to make beverages. There are few small canning plants for mango pulp and fruit canning. The industry as a whole is yet in a very elementary state. It can develop in rural areas as a small scale industry.

In Maharashtra the Assam mango Mangifera assamica which has rather bottle-like shape is not much cultivated, nor the large size fruiting variety Malda, or sweet starchy variety Dashahari which grow best round about Banaras, Patna and Lucknow. But there is no research station nor any society for the study of mangoes. The world famous author of the book "The World was my Garden", Fair child, had been to India, in Bombay and Pune, to collect seed of various varieties early in this century, and took the seeds and slips of various important varieties to South America and successfully grew them in Miami, where there is a huge garden of tropical trees the Huntington Park. Most of the tropical fruits of the world are grown there. Some Indian mango varieties are now cultivated in South America and Africa too. They develop their own flavour and are quite juicy. Their pulp is sold in the markets of England, America, Europe and Egypt around the Suez Canaltowns. It is far less tasty than the pulp of the Indian mangoes. Dr. Cheema of Pune had made a lot of effort for exporting mangoes and for their preservation. The Ganeshkhind Botanical Garden developed by Woodrow became a Fruit Research Station, where several varieties of mangoes are cultivated and grafted successfully.

In Konkan area along the hilly slopes, where the rainfall and drainage are good, are full of cashewnut trees, introduced in the 15th century by the Portuguese invaders. They grow well here. The Portuguese had brought some other fruits also from Brazil, South America, but cashewnut is the one which has prospered well in Konkan climate. It is grown in Ratnagiri, Malvan, Vengurla, Sawantwadi, Goa and Ajra region of Kolhapur. It is also grown in Bombay. The coastal areas to the north of Bombay have them, but they do not produce fruit so abundantly as in Ratnagiri. A few factories for decorticating and processing the cashew seed and roasting are seen in Sawantwadi and South Ratnagiri towns like Malvan. The seed of cashewnut is used as dessert after frying.

Another fruit which is introduced in Sawantwadi area is Cocoa (Theobroma cocoa). This fruit also grows well in Konkan upto Bombay. It was introduced in Sawantwadi area first by Dr. Dalgado. He used to bring cocoa seeds from Sri Lanka. He grew them successfully in Sawantwadi area. In Bombay also the cocoa plant does well but there is no data on its bearing.

Among the other fruits Sapota (Achras sapota), Lichi are important. Sapota and Lichi grow best in Dahanu area and round about Kosbad, Bordi on sea coast. The plant needs equable climate and plenty of subsoil water for its growth and sandy soil. For ripening it also needs hot sunshine. Such conditions are available only in the area around Dahanu and therefore huge orchards of Sapota or Chiku and some of Lichi are grown there. Except two rainy months July and August, the fruit is seen on trees throughout the year and is exported to all places in the country. There are two varieties of it, those which produce round fruit and those that have oval conical fruit. The latter fetches good price. The round variety has more peps, the oval conical variety has smooth flesh and few peps. Lichi is also grown in gardens in Dahanu area mainly by the Iranian cultivators who are permanently settled there. The fruit is produced in small quantity. It is not so tasty, nor has the same flavour as that of fruit in Uttar Pradesh, Bihar or Assam.

Guava is a South American fruit and is popular throughout Maharashtra. Many varieties of it are seen, but the Lucknow variety which is grown has smooth pulp and not many seeds, or has only soft seeds. It is

supposed to be the best. The pink fresh varieties both round-oval and pyriform are available from Dahanu and Nasik. The country variety though a heavy bearer is not much cultivated. The fruits of a variety selected by Dr. G. S. Cheema is grown in orchards at Pune. Besides these main fruit trees, a number of other fruit yielding trees are also grown in Maharashtra.

Miscellaneous Fruits-Wild or Cultivated:

Bor or Zizypus jujuba.—There are both wild and cultivated varieties of this fruit throughout Maharashtra. It grows wild and produces abundant fruit in winter and comes to end by the beginning of summer. The varieties of Bor or Ber have round or oval shape. The latter are known as Banarasi. Their cultivation is seen at Mehrun in Jalgaon district and at Baner near Pune. At all other places the round varieties grow either wild or are cultivated. Main difficulty in Bor production is pollination. While pollinating, the insect lays eggs in ovary and larvae are developed inside the fruit. Most of the fruit is spoiled as the insect larvae develop. Consequently the fruit is not so popular. But some wild varieties do not possess them. The fruit is mostly wasted in rural area where it is not collected.

Myrobalans.—Among the wild fruits in rural areas Myrobalans must be mentioned. They are the fruits of Terminalia chebula. They are highly prized for tannin which is about 30-40 per cent higher than in any other tannin yielding material. It is also used in Ayurvedic medicines e.g. Triphala. There are half a dozen tennin extracting factories in the country one near Calcutta, another near Jabalpur, one in Maharashtra at Amba. The plant grows abundantly in Gaganbavda area, Bhor, Junnar, Tryambak areas, in Satpudas, in Khandesh and in Madhya Pradesh. The fruit is largely gathered by the local people and sent to Bombay for exporting to Germany, England and other countries where the tannin is needed for several purposes such as Calico printing, for softening water in boilers, in the preparation of ink and other preparations in which tannin is added as a preservative. There are two varieties of it, large oval and small round. Latter generally is found in this State; and the oval and large, locally known as Survari Hirda is obtained from the hills around Jabalpur and Chhindwada. The other species of Terminalia T. bellerica also yields fruit containing tannin, but it is used mainly in medicine. The possibility of utilising this fruit for tannin extraction is not explored.

Some Other Fruits:

In addition, some other fruits are available in Bombay market They belong to cucurbit family. Some fruits are of wild trees of drier places, Khirni or Rayan (Mimusops hexandra). Some wild fruits grow in ghats. They are Karvanda, the fruits of Carissa congesta. They grow in abundance in hilly regions. They are popular but are not found in all places. Chivar are the fruits of Elagnus latifolia. They are available in ghats and Dangs. They are not very common in forests and grow only at high altitudes. Karmal (Averrhoa karambola) has sour fruits. They are also available seasonally, but are mostly used as an adjunct to vegetables. In Konkan region, another very important tropical fruit is Garcinia indica. The ripe fruits are collected, dried and extracted for coloured sour juice. The percentage of acidity is increased by adding this extract to fruits, dried and then sold in the market as Amsulor Kokam, Seed yields an edible fat solidifying at room temperature.

A regular survey of various wild fruits in our State has not been made. The fungi infecting fruits and vegetables stored in market have been studied by Dr. V. G. Rao of M. A. C. S., Pune. Available information of them by Dr. V. G. Rao is given in the Section on 'Fruit Rotting Fungi'.

A few other fruits, both wild and cultivated, are worthy of note but not used on fully commercial scale. They are the fruits of Mahuwa, Rayan or Khirni, Tamarind, Bel, Kawath or Wood apple, Timbru or Tembu, Kamra, Olive, Charoli, Waghante, Cappers or small fruits of Capparis sepiaria and other species.

Mahuwa are the fruits of Bassia latifolia found in large quantity in Vidarbha. Stray plants of it occur in other parts, but they are quite common in Satpudas in Khandesh. The flowers are collected and eaten by the Bhils and Kolis during summer when their food reserves get depleted. The fruit is fleshy, contains latex and some sugar, but not much. On drying it gets easily fermented due to yeast. Therefore, they are collected in large quantities by the tribals, who make country wine like the cashew wine.

In a similar way, they also collect fruit of Rayan or Mimusops hexandra which is plentiful in Thane and Dang forests, but elsewhere only in dry places such as near Ahmednagar. It is not very common. The fruit of this tree is a small berry highly nutritious and sweet. It is not used for making wine of any kind, but is eaten raw as soon as it is ripe. It comes from Balsad and Billimora areas to Bombay, Ahmedabad and in other markets. Its stalk is used for grafting Sapota (Achras sapota) plants in Dahanu and other places in nurseries in Thane district.

Tembu or Tembru is the fruit of Diospyros montana. The fruit is tasty somewhat like Kaki (Diospyros kaki), but does not have the same size as Diospyros kaki.

Kawath and Bel are very common in use. The fruit of wood apple or Kawath (Feronia elephentum) comes in the market after rainy season and fetches a moderate price, but its capacity to get preserved is not much as either the pulp gets dried, or there is fungal infection inside. Therefore. the fruit after it is ripe has to be used within a few days. Another fruit of a similar nature is that of Bel (Aegle marmelos). There are two varieties of it: the Banaras variety and the country variety. The fruits of country varieties are small and Banaras variety are relatively large. pulp of country variety is not very sweet and therefore that is not used, except for medicinal purposes, for making Sharbat or jam. The Banaras variety on the other hand, has more sweet content, more pectins and sugars. It is used for making Sharbat. There are wild plants of Aegle marmelos in the hills of Satpudas and in drier areas of ghats in Khandesh and Aurangabad. The plant, however is highly medicinal and is much in demand by the Ayurvedic physicians for its pulp which is supposed to cure the disorders of stomach.

Jambhul or Jamun.—This is a fruit of Eugenia jambolana. Several varieties of this are found at different places but the taste is the same. Only size of the fleshy part of fruit differs. The fruit is much prized by the people who suffer from diabetes, but there is hardly any proof for it. The tree is not cultivated but wherever the seeds fall it grows. This tree is very hardy. Its timber is useful for making wooden base of certain musical instruments and furniture because of its compact timber. There are no nursery plantations of these trees anywhere in Maharashtra.

Equally wild is Bassia latifolia in Vida bha especially Amravati. The trees of Buchanannia lanzen produce fruits which contain an oily seed sold in the market as Charoli. The trees of this are cultivated for oily edible seeds.

Olives.—An experiment to grow another oily seed bearing fruit in Maharashtra viz., Olive (Olea europea) plant was made by Dr. Gibson. It is easily propagated vegetatively but it does not produce flowers and has no vector to pollinate. The result is that the tree remains barren all the time. The European olive is said to produce seed at Ranchi, but nowhere does it do so in Pune or Hiwre area or in other parts of India. There are two full-grown trees of it growing well in the Ganeshkhind Garden, Pune, opposite the Poona University building. They also are cultivated out of fancy elsewhere. The plant, though promising, has not been tried experimentally. Olives grow on calcarious soils and are much prized in Europe as a material for pickles, and their seeds for extracting olive oil useful as a cooking medium, and in the preparation of Margarine-like fats.

There are two other fruits grown in Alibag, Ratnagiri and Sawantwadi areas. They are the fruits of *Piper longum* and Jaifal or *Myristica fragrans*. From the previous records it is clear that both these plants were grown by Portuguese and Dutch in Konkan at a number of places, bringing vines from Malabar, but at certain stage the culture of peppers was given up. It has recently been restarted at Dapoli.

It will be seen from above that a large number of fruits which are wild have not received any attention at the hands of botanists, which they certainly deserve.

Tamarind.—Tamarind was known to Arabs and Egyptians as Tamare-Hind or Indian fruit used as spice. It was a favourite article of export from India. Amala or Avale is the fruit of Phyllanthus emblica. It is a rich source of vitamin C, and is used in a number of Ayurvedic preparations like Chyavanprash.

Several foreigners that came to India have brought them and got them introduced. That is how we have many fruits which are alien to India. Bombay, Surat, Goa and Cochin were the first places where they came. But no systematic effort is made to expand their cultivation or improve the quality or that of wild fruits. The subjoined statement shows the origin of different fruits from different parts of the world and time since they are being used. Seeds of Tamarind, Bor or Jujube have been found in archaeological sites which throw light on their history.

Common fruit trees and their origin

Fruit tree		Original home	Common since
(1)		(2)	(3)
1. Common apple (Pyrus malus)	••	Temperate Europe South-west, Asia South-west, not cultivated in Maha- rashtra.	Prehistoric
2. Common cherry (Prunus sativum) A-127—51-A	er a	Asia	Ancient

Fruit tree	Original home	Common since
(1)	(2)	(3)
3. Raspberry (Rubus idoeus etc.)	North Temperate region.	
4. Garden strawberry (Fragaria vesca)	Chili, California	
5. Grape (Vitis vinifera)	Mediterranean Western basin, Western temperate Asia.	Used from prehistoric.
6. Musk melon (Cucumis melo)	India, South-west Asia, Tropical Africa.	
7. Water melon (Citrulus vulgaris)	Tropical Africa	Prehistoric
8. Orange (Citrus aurantium)	China, Cochin, East India.	Ancient
9. Lemon (Citrus medica var Limon)	India	Ancient
10. Banana (Musa sapientum)	South Asia, India	Prehistoric
11. Date (Phoenix dactylifera)	South-West Asia, Arabia, North Africa.	Prehistoric
12. Common Fig (Ficus carica)	North Africa, East Mediterranean region	Prehistoric
13. Pineapple (Ananas sativa)	West Indies, Central America.	Ancient
14. Olive (Olea europea)	Asia Minor Greece, Italy.	Prehistoric
15. Cocao (Theobroma cacao)	Northern South America, Central America.	Prehistoric
16. Sago palm (Metroxylon sagu)	Sunda and Molucca Islands.	Modern
17. Bitter cassava . (Manihot utilissima)	Northern South America.	Ancient
18. Tamarind . (Tamarindus indica)	. India	Prehistoric

6. PRESENT CROP PATTERN IN MAHARASHTRA

Crop pattern in Maharashtra has been studied by agronomists from time to time. The latest one is by Dr. M. V. Chavan and J. A. Patil, described in 1968 in *Deccan Trap Symposium*, INSA Bull. 48: 10-18. The following one is mainly on the basis of information supplied by Dr. V. S. Rao of M. A. C. S. Research Institute, Pune. It will be seen that the crop pattern is changed from time to time, but curiously enough in certain parts of Maharashtra it has remained practically unchanged for years. For example, in the archaeological sites at Jorwe and at Newasa in Ahmednagar district, we get grains of bajra (Pennisetum typhoideum) and kulith or lentil (Lens esculenta). These grains of Bajra and lentil are easily comparable with grains cultivated in those part

of Ahmednagar even today. This means that since the archaeological time, which has been estimated about 2300 years by carbon dating, there has not been much change in the crop cultivation. This speaks of great conservation on the part of people there. But this trend is now fast changing since the discovery of hybrid crops, which give high yield in cercals. Dr. Borlough of Sweden is the originator of dwarf hybrid crops, and in our country Professor M. S. Swaminathan. It has revolutionised the whole crop pattern of cereals. Accordingly the crop pattern has changed in Maharashtra also. At present the general trend is to cultivate hybrid dwarf variaties of wheat, bajra, jowar, rice, for high yields. They have rather loose ears. But at the same time, some of them are easily attacked by the local fungi and insects. Therefore, all precautions have to be taken for avoiding them by using fungicides and insecticides. They need high fertiliser doses and plenty of water. Without sufficient fertilisers and water they are not able to give higher yield. They also give less fodder as they are dwarf and have less foliage.

The crop pattern depends upon the climate of agroclimatic zones. Broadly speaking, the agroclimatic zones depend upon the annual rainfall and the type of soil that has to retain rain water. There is a zone of high rainfall in Maharashtra as indicated earlier, as well as certain other regions which are proverbially scarcity zones e. g. Sholapur, south and east part of Pune, Ahmednagar and parts of adjoining Marathwada They lie more or less in scarcity zone. On the other hand, the parts little close to the main ranges of Sahyadris are known for high rain-The agroclimatic zones are accordingly classified as high rainfall zone, low rainfall zone and the scarcity zone. It is the drought period which is most dreaded by the agronomists, because of the uncertainty of yearly rains and its amount. On an average in about 35-36 years there is generally a bad period of scarcity. The greater part of Maharashtra, have a rainless period of about 7-8 months in a year. Therefore, the agronomic practices largely utilise the early growing varieties of crops. On the other hand much prized varieties of rice and also of jowar are generally the long season varieties. Some of the best varieties of rice in Maharashtra such as Jiresal, Ambemohor or new varieties of jowar such as Ashwini or Maldandi, Suwarnarekha are grown as Kharif season crop. In agronomically medium rainfall zone crops grown are generally Rabi. Therefore, the following account of the crop pattern is broadly based on these agroclimatic zones and the climatic conditions favouring them.

Deccan Region:

Deccan is mostly a low rainfall tract, and as such most of the cultivation is rain-fed. But in places served by the Deccan canals, crops fed by irrigation are taken. Thus, we find in Deccan two strikingly different crop patterns, (i) in rain-fed tract and (ii) in irrigated tract.

In the rain-fed area, jowar or bajri is the most important crop in the Kharif season. Seed is sown soon after the onset of monsoon rains. Jowar is intermixed with pulses like *udid*, *mung*, *chavali*, *tur* etc. It is a common practice to sow one or two lines of them after every 6 to 8 lines of jowar.

Khariferop of jowar is followed by a rain-fed crop of wheat or safflower, growing on residual moisture after monsoon rains. In some places wheat and gram are intermixed in proportion of 3: 1 with a sprinkling of mustard.

The irrigated areas of Deccan are mostly in the districts of Pune, Sangli, Satara, parts of Ahmednagar and Nasik. Sugarcane is the most dominant crop of all these areas. It is taken as the main crop and the succeeding and preceding crops are decided as and when the land becomes ready for sowing. Sugarcane is planted in three seasons. Adsali is planted during July-August, pre-winter is planted in October-November and Suru planted during January-February. These take nearby 18, 15 and 12 months, respectively, for maturity. Sugarcane is occasionally intermixed with bhendi, jowar, tomato, cucumber, chillies or onion. To achieve maximum returns out of the investment, the sugarcane crop is quite frequently rotationed.

Rice is grown in rotation with sugarcane in Kharif, followed by gram or wheat in Rabi.

Cotton is also grown as a Kharif crop with groundnut in the next Kharif season, thus giving a three-course rotation.

Another three course rotation is: sugarcane, Rabi jowar, Sann hemp.

In the Sangli-Satara districts, sugarcane is rotated with turmeric in Kharif, followed by jowar in the next Kharif.

In Pune and Satara districts, Kharif crop of jowar or bajri is followed by a Rabi crop of potato, whereas in Ahmednagar and Nasik districts, potato is taken in Kharif, followed by Rabi jowar or wheat.

In Nasik, Pune, Sholapur, Satara and Ahmednagar districts, in large areas onions are grown and also garlic in the Rabi season.

Tobacco is another important crop of the Deccan, particularly in Sangli district which along with Kolhapur district, accounts for 90 per cent of the total area under tobacco in Maharashtra. The tobacco is mostly of types suitable for bidis. It is mostly grown as a monoseasonal crop without any rotation. Other minor crops of Maharashtra area are sesamum, which is grown in Kharif, Rabi, as well in summer and groundnut which is only occasionally grown as a summer crop.

Crop varieties grown in Deccan

Jowar .. CSH-1, CSH-5, Swarna, Maldandi, Dukri.

Bajri .. HS-1, HB-2, HB-5.

Sugarcane .. Co-419, Co-678, Co-740, Co-775, Co-798.

Rice .. Ambemohor-157, 159, 102, EK-70, Krishna-sal

IR-8, TN-1, Jaya, Hansa, Padma.

Wheat .. N-59, MACS-9 (for rainfed) and NI-146, Sonalika, Kalyansona, CC-464, Khapli (for irrigated tracts).

Gram .. N-59, N-31.

Safflower .. N-630, 628, 300, 7, NP-30, CT-11.

Groundnut ... At-8-11, Karad 4-11.

Turmeric ... Rajapuri and Karadi (soni).

Potato .. Kufri chandramukhi, Kupri sundani.

Onion ... Kharif-Niphad 5-2-8, 5-7-1, 123-7-1, 241, 2070-1.

Tobacco ... Vars. P-19, K-20, K-49, G-6, S-20.

Sesamum .. Nos-8, 85, 128.

Konkan Region:

Due to the high rainfall and hilly terrain the crop cultivation in Konkan area is of a limited nature, while plantation crops form the chief source of income of the farmers.

Rice is the most important crop of this region and is grown in Kharif season. Other millets grown in Konkan during Kharif are kodra and kodo millet (Paspalum scrobiculatum), vari(Bhagar)(Panicum miliaceum), and ragi or nachani (Elusine coracana) grown in the districts of Ratnagiri, Raigad, Thane and Kolhapur. The Kharif crop of rice is rotated with legumes or beans. They are sown during Rabi season. To some extent groundnut is also grown in Kolhapur district, but more in Jalgaon and Pune districts.

Another rotation practised is nagli (Pearl millet) for two years followed by sesamum or til for one year.

In the transitional areas of Kolhapur district, sugarcane is grown, followed by turmeric or tobacco.

Crop varieties grown in Konkan

Rice .. Kolamba-42, Kolamba-540, Garvel-1-8, Kolavati-1-24, Dagda-627, Patri-6, Warangal-486, Jaya,

Satya, Surya, Suhasini,

Sugarcane .. Co-419, Co-67, Co-740, Co-775, Co-798.

Gram .. N-59, N-31.

Groundnut .. Kopargaon-1, Kopargaon-3, SB-11, AK-8-11.

Ragi .. E-11, E-31, And A-16. Sesamum .. Nos. 8, 85 and 128.

Vegetable crops:

Wherever facilities are available, farmers take to inter-cropping under either canal irrigation or well irrigation. In many districts of Maharashtra vegetable crops are grown.

सत्यमव जयत

In Jalgaon, Satara, Beed, Nanded, Osmanabad and Nagpur districts coriander is grown on large scale both during Kharif and Rabi seasons. It is rotated with wheat, gram, jowar or onion or mixed with cotton, sugarcane, onion or brinjal.

Other vegetable crop mixtures are—

- 1. Cabbage and cauliflower in mixture or alternate rows and knolkhol in water channels.
- Cabbage or cauliflower in beds or ridges, radish, beet root, lettuce in water channels.
- 3. Cucurbit mixture consisting of red pumpkin, bottle gourd, snake gourd, khira, bitter gourd and radish along channels.
- 4. Bhendi-jowar in alternate rows.
- 5. Sugarcane is farmed with *bhendi*, cucumber, chillies on sides of ridges.

Crop rotation in Khandesh (Jalgaon and Dhule districts):

Because of the predominance of black cotton soils, the most important crop of Khandesh is cotton. It is grown both as a rain-fed crop and as an irrigated crop. The rain-fed crop is sown after the onset of monsoon i. e., June-July. The irrigated crop is sown earlier in May. Intercropping of cotton is a usual practice. Common among these are:—

(1) 1-2 lines of Ambadi after 10-15 lines of cotton with or without Ambadi (Hibiscus sabdarifa) sprinkling, and (2) cotton 8 lines and 2 lines of Kharif Jowar. In region where intercropping of cotton with soyabean is also recommended, the general recommendation is—two lines of soyabean in between two cotton rows. Cotton picking starts from October and extends up to December and January. The land remains fallow till the next monsoon. However, some take also a Rabi crop of wheat or jowar or gram if the cotton picking is over by December.

During the susbsequent Kharif season, depending on 2 or 3 years rotation, jowar or groundnut are grown.

Cotton-jowar (2 year rotation).

Cotton-jowar-groundnut (3 year rotation).

Cotton-groundnut (2 year rotation).

The jowar crop is generally intercropped with udid, mung,

In the north-eastern parts of Khandesh, wherever irrigation facilities are available, banana is successfully grown followed by a broadcasted crop of wheat on residual soil fertility.

To some extent, and on a limited area onion and chillies are grown depending on the availability of irrigation facilities. Onion is grown both in Kharif and Rabi seasons, whereas chillies are grown either Kharif as a rain-fed crop, or as a Rabi winter crop or even in hot weather, during February-March if irrigation facility is available.

Crop varieties grown in Khandesh

Cotton .. Buri L-147 (G-hirsutum), Virnar, Gaoran-22.

Cotton—Gaorani- (G.-artsoreum) AK-235 (derived from a cross 46. H-420 × 487) and H. 4.

Jowar .. Aispuri (Fodder-cum-gram variety for Kharif),

. Gaoran (Kharif variety), CSH-1, CSH-5 and Swarna.

Groundnut .. AK-12-24, Faizpur 1-5. Gram .. Chaga, N-59 and N-31.

Wheat .. NI-146, NI-973, NI-747-19 or Kalyansona under irrigated conditions, and N-59 MACS 9 and NI 5439 for unirrigated conditions.

Tur .. H-290-21, T-84, C-11,

Mung .. Baisakhi Mung, Kopargaon Mung.

Udid .. Sindkheda-1, D-6-7.

Chillies .. Dharwar, Sankeswari-C2, and C-9.
Cinion .. In Kharif season Niphad 53, 404 M, 490.

In Rabi season, Niphad 5-7-1, 123-7-1, 5-3-8, 2070-1, 241.

Soyabean

Clark-63, Monetta, Brangg Anker.

Vidarbha and Marathwada Regions:

As in Khandesh, cotton is an important crop of Kharif season. Sowing season is the same as in Khandesh, June-July for rain-fed crop and March-May for irrigated crop. Intercropping of cotton is a usual practice. The common practices are (1) cotton-10-15 lines with 1-2 lines of tur, or (2) cotton 10-15 lines with tur 1-2 lines with ambadi sprinkling, or (3) cotton 8 lines and Kharif jowar 2 lines. In recent years intercropping of cotton rows with two rows of Soyabean is also recommended.

The most important Kharif crop however is jowar which is grown in rotation with cotton under rain-fed areas. Other Kharif crops grown in rotation with cotton are tur, bajri and groundnut. If the cotton prices are remaining high or steady, cotton is grown successively for two Kharif seasons after which another rotation crop is taken. One variation of this is gram rotation, cotton-jowar-wheat rotation followed in some parts. The Kharif jowar crop is invariably intercropped with udid, matki or mung.

In some parts mung is taken as a short Kharif crop followed by a Rabi crop of wheat.

In places where cotton cannot be cultivated groundnut is taken as a summer crop, sown during the months of January-February, followed by a Kharif crop of bajri. Sometimes, the summer crop of groundnut is followed by rain-fed cotton in Kharif season and jowar in the next Kharif season.

Safflower is another Rabi crop grown mainly under rain-fed condition, because of its handiness. This is either grown as a sole crop or intermixed with the rain-fed wheat crop.

In the Marathwada region linseed is also grown in Rabi season and is rotated with wheat, gram, coriander, jowar, udid and tur. It is sown in October and harvested in January.

In Bhandara and Chandrapur districts of Vidarbha, rice is cultivated successfully in the Kharif season. To some extent turmeric, chillies, tobacco, linseed, sesamum are also grown.

Crop varieties grown in Vidarbha and Marathwada regions

Cotton .. Buri-147, H-4, Varalaxmi, Gaoran-6, Gaoran-12, Gaoran-22 and Gaoran-46.

Jowar ... CSH-1, CSH-2, CSH-5, Swarna, PSH-2.

Bajri ... HB-1, HB-3, HB-5.

Tur .. T-148, Tur-Hyderabadi, C-11, Pt-301.

Groundnut .. Spanish improved, Kopergaon-1, Kopergaon-3, improved, Small Japan.

Wheat .. N-59, MACS-9, (for rain-fed conditions) Kalyansona, NI-5437 (for irrigated conditions).

Udid .. Sindkheda-1, D. 6-7, Udid-55.

Deccan and Warangal. Gram

N-7, 300, 628, 630, NP-18, NP-30, CT-11. Safflower

EB-17, Triple Burma, EB-27, Tuljapur, Jaya IR-8 Rice

Hansa, Padma, Karjat 184.

Gujarat or local variations. Tur

Kopargaon Mung. Mung

Malshiras-10, Sholapur-36, N-3 and N-55. Linseed

Clark-63, Monetta, Bragg. Soyabean

Thus the present crop pattern in Maharashtra is not what it was some years ago, and it is probable that it may also change somewhat in future. But since the rainfall on the whole, and the soils are varied—some black cotton, some sandy mixed or lateritic, not much change is expected. The varieties may change after trials, and may be cultivated with some old disease resisting varieties evolved through long years by experience. Pattern of crop plants in pre-historic and historic times is described in the following pages and may be compared with the present one to look for improvements.

ANCIENT CROPS IN MAHARASHTRA

There are several archaeological sites in India as well as Maharashtra. From these some foodgrains and seeds have been recovered and their account is given by Dr. Vishnu Mittre in Transactions of Bose Research Institute 21 (3), 1968, and that of grains in Maharashtra has been given by Dr. M. D. Kajale at the first Geophytological Conference, Lucknow, 1975 (Geophytology, Vol. 7: 98-106, 1975). In Maharashtra they are found at Bhatkuli in early historical period, at Amravati and Paunar (400-500 B. C. to 3-6 centuries A. D.), at Newasa and Soyegaon in Ahmednagar district and at Inamgaon in Pune district. The study of archaeological plant remains throws light on the crops, trees and agriculture in those prehistoric times, both in India as well as in Maharashtra. The following Tables give the foodgrains and their popular names enlisted by Dr. Kajale (1975). It will be noticed that they belong to different periods as indicated in Table 1X-B-7.2.

TABLE IX-B-7.2

SHOWING LIST OF CHARRED GRAINS FROM ARCHAEOLOGICAL SITES AT NEWASA COMPILED BY M.D. KAJALE, 1975.

List of grains with popular names

Hordeum vulgare Linn.					Barley
Oryza sativa Linn				• •	Rice
Triticum ct. sphaerococ		• •	• 6.0	•	Wheat
Paspalum scorbiculatun					Kodo Millet
Eleusine sp		• - •	• •	••	Finger Millet
Pennisetum typhoides S		ubbar	d	•1•	
Sorghum sp					Sorghum Millet
Carthamus tinctorius L	inn	***			Safflower
Phaseolus mungo Linn.		•••	***	*1.*	Udid
Phaseolus sp	•	•	-		Green gram Black gram

Dolichos lablab Linn.	• •	• •	• •	• •	Hyacinth Bean
Lens esculentum Moench.					Lentil
Pisum arvense Linn					Peas
Cicer arietinum Linn.		• •		• •	Chick pea
Lathyrus sativus Linn.					Grass pea
Zizyphus sp					Indian Jujube
Tamarindus indica Linn.					Tamarind

TABLE IX-B-7'2

Stratigraphic Distribution and Age of Charred Grains Obtained from Newasa and of Those in other Countries.

Grains		Chalcolithic Period I 1500 B. C. to 1000 B. C.	Satavahana Period II 150 B. C. to 50 B. C.	Indo-Roman Period III 50 B. C. to 200 A. D.	Muslim- Maratha Period IV 1300 A. D. to 1800 A. D.
(1)		(2)	(3)	(4)	(5)
Barley		-50		•	
Rice		- 680		•	_
Wheat	٠.	• (8)		•	•
Kodo-millet		- Chi		•	•
Finger millet	٠.	- 11	111111	•	-
Pearl millet	٠.	- 45	7 CON 5 7	•	
Sorghum millet	٠.	- (Edit		•	•
Safflower	••	772	गोन जगने	•	•
Green gram		440	4.44 4.42	•	
Black gram			•	•	_
Hyacinth pea	••	_	• •	•	
Lentil lens	••		•	•	_
Field pea		•	•	•	•
Chick pea (Gram)	• •			_	•
Grass pea		•	•	•	
Indian Gram	٠.	•	_	•	•
Jujube Ber				_	
Tamarind		_	•	-	-
Unidentifiable seeds	3	-	•	•	•

[•] Present —Absent

These grains were used as food by the people from chalcolithic times almost to the present time at Newase and around. The Chalco lithic culture was succeeded by Satavahana culture dated 150 B. C. to 50 B. C.

Some unidentifiable fruits were also found. At Newasa and Jorwe tamarind seeds were found. Indo-Roman culture was spread in India from 50 B. C. to 200 A. D. It also showed the charred grains enlisted above. But no Sorghum or safflower seeds appear to have been introduced newly in the cultural phase of Indo-Roman culture. In India tamarind seeds have been found in the tombs dating 2000 B. C.

At Kolhapur also charred Sorghum and tamarind seeds were found. There are several sites of Satavahanas such as Bhokardan, Ter, etc. Each of these sites has its own flora: For instance at Navadatoli near Maheshwar in Madhya Pradesh seeds of pigeon pea Cajanus cajan and Lentil seeds were found in abundance. Even at Maheshwar in Madhya Pradesh near Indore, and at Newasa, oilseeds of safflower were found. However, safflower or its seeds do not suggest any significant climatic change. The grains found here are mostly Paspalum scorbiculatum L., wheat grains, coriander seeds, grains of Barley (Hordeum vulgare). All these grains found here are carbonised or semi-carbonised. Sorghum also is now reported in Maharashtra, from Inamgaon on the bank of the river Ghod in Pune.

Some pollen grains have also been found from some sites such as Higaon, but not elsewhere. The relative ages of the chalcolithic to early historical time is as follows:

The study of archaeological plant remains such as foodgrains and seeds throws light on the crops, trees and agriculture in those prehistorical days in India as well as in Maharashtia. Several important archaeological sites on the banks of rivers such as at Jorwe, Newase, Ter, Inamgaon, Pune have been thoroughly studied by Dr. H. D. Sankalia of the Deccan College, Pune and his associates. The list of grains given by them and by Kajale above contains Bajari (Pennisetum typhoides) and Lens esculantum (Masoor). They are still being cultivated in the same areas for ages. The age of some of these carbonised grains by carbon dating method was found to be about 1200 B. C. which means they have had been cultivated for more than 2000 years. This is rather interesting as it suggests that the crop pattern in Maharashtra till recent time is not much changed and is conservative.

The crop pattern as it is today has been given earlier. If it be compared with the one which was in existence before 25 years ago, it will be seen that it is now largely made up of new hybrid varieties of bajari, wheat, rice etc. The traditional varieties of grains are also cultivated side by side with the new ones for their capacity for resistance and the flavour liked by people. The hybrid varieties are chosen because of their high yield. However, it is necessary to note here that Maharashtra being largely dependent on rains, the rain-fed varieties and short season ones are more important in dry farming areas. It is only now that serious efforts are being made to develop such varieties as could grow successfully despite low and erratic rainfall. One such very successful high yielding variety

of wheat grown on rain water only has been developed by the Maharashtra Association for the Cultivation of Science (M. A. C. S.), Pune, under the name MACS-9, and is now distributed to farmers. It is a suitable variety for drier areas of Maharashtra, Andhra Pradesh, Mysore and part of Madhya Pradesh. The rain-fed varieties of other crops are yet to be developed. Some new varieties of rice have been developed at Ratnagiri, Kosbad, Dapoli, viz., Bluebell variety or its derivatives by Dr. M. S. Pawar. In Mulshi, Bhor and Nasik areas new varieties of rice similar to Ambemohar or Kamod have been developed. New varieties of groundnut are developed at Oil Seeds Research Station at Jalgaon.

8. ORIGIN OF AGRICULTURE IN INDIA vis-a-vis MAHARASHTRA.

Origin of Agriculture in India is unknown, but evidence is now forthcoming of the antiquity of Neolithic culture. In that the local crop of millets, rice was also grown, but their exact origin is still unknown. During Mesolithic period animal domestication seems to have begun. It must be prior to plant domestication. Wild grasses were reaped and some were cultivated for food. Cultivation of wild grasses for food as cereals is done even now by the hill tribals e. g. wild rice (Oryza sativa), or in kumali or shifting cultivation. Extra-local crops entered India at the extreme north-west and got diversified in various cultures at different places west to east and north to south. Rice entered Ganga plains from the north-east where some wheat, barley cultivation was already in existence. During the later ages wheat and barley spread down to south. Cultivation of wild grasses, legumes such as Dolichos biflorus or Phaseolus mungo, P. radiatus seems to have been practised and domesticated in India (Maharashtra and Madhya Pradesh) in Neolithic period and in the post-Neolithic period (See Vishnu Mittre, J. Human Evolution 1978, 7: 31-36.)

9. ECONOMICALLY IMPORTANT PLANT FAMILIES

We shall now consider the economically important Angiosperm families in Maharashtra State. Out of 117 families in it, economically important families are only about 15. Complete economic botany of Maharashtra has not been studied, although the various government publications and Reports on the marketing of crop plants and commodities are published from time to time. The Agricultural department also published data regarding the crop plants periodically, and since their production and prices change from time to time, they have not been considered here. A complete marketing survey of the fruits and fruit vegetables at Bombay was made by Prof. P. V. Bole then of the St. Xavier's College, Bombay, giving account of the botany of the fruit vegetables, their marketing conditions in Crawford market in Bombay.

Timber trees form an important section of Economic Botany. The Gazetteer of Bombay State, (Revised Edition), Botany Part II-Timbers. by Prof. S. P. Agharkar was published in 1957. It gives account of all the Timber species. Prof. S. P. Agharkar has also given a comprehensive account of the Medicinal Plants of Maharashtra in the Bombay State, (Revised Edition-1953), Gazetteer Botany Cultivation of medicinal plants is now Part I-Medicinal Plants. done in Jawaharlal Nehru Udyan or Botanical Garden of Ayurvedic Medicinal Plants at Kothrud near Pune. A large number of medicinal plants are used in the indigenous systems of medicine. However not much work has been done on their cultivation, ecology, analysis or pharmacognostic characters. The last chapter of Medicinal Plants of Bombay by Agharkar (1953) summarises important botanical aspects yet to be tackled successfully.

We shall therefore, consider here other economically important plants. The figures of total revenue from forests in Maharashtra are given below, obtained through courtesy of Dr. I. M. Qureshi, Chief Conservator of Forests, Maharashtra State.

1. Gross revenue from forests in Maharashtra State-

Year			Gross Revenue
		(Rs. lakhs)
1978-79	• •	• • •	5,228.32
1979-80	-		5,219,53

2. Gross revenue from forests in Chandrapur district—

Year	577	257	Gross Revenue
,	434	SE.	(Rs. lakhs)
1978-79			1,707.54
1979-80	631100	•••	1,858.65

The study of flowers commonly used by people has always attracted the attention of botanists. Brev. Col. Dr. K. R. Kirtikar has given an interesting account of the common flowers used for worship and also of the poisonous plants occurring in Maharashtra and their poisonous properties in the *Journal of the Bombay Nat. Hist. Soc.* early Vols. before 1900 and published separately in (1898).

Study of the various families shows that all families are not of equal importance from the viewpoint of Economic Botany. Amongst the medicinally useful families, the following are rather important: Rubiaceae, Compositae, Leguminosae, Labiateae, Celastraceae, Verbenaceae, Plumbaginaceae, Solanaceae, Flacourtineae, Combretaceae, Gentianaceae, Asclepiadaceae, Apocynaceae, Convolvulaceae, Piperaceae Euphorbiaceae, Liliaceae, Palmae and Gramineae.

From the viewpoint of timbers, important timber yielding species belong to Rubiaceae, Verbenaceae, Combretaceae, Anacardiaceae, Meliaceae and Leguminosae. Some timbers are used for specific purposes, as the qualities and properties of various timbers differ considerably, their use also accordingly is varied and restricted to certain purposes. The data regarding the yield from various species is not available but the total revenue that accrues to the State Government is known and has been given on last page, figured wood of teak fetches 3-4-times prices for *Tectona grandis* wood of Alapalli in Chandrapur.

Among the miscellaneous forest products a special mention must be made of the spices belonging to families Piperaceae, Umbelliferae, Rutaceae, Gramineae, Acanthaceae, Celastraceae. Cultivation of spices like black or white pepper Piper nigrum or P. longum, Nutmeg (Myristica fragrans) Allangium lamarkii is not much practised, but is worth doing. Other spices Clausena indica, Garcinia indica grow wild and are collected

mostly from Konkan and Ghat regions. The cultivation of cloves (Eugenia caryophyllata) is tried at times, but as there is no pollination, no cloves are obtained. The same is the story of Olive (Olea europea). It grows well at Pune and at hill stations, but it does not bear fruit, as the vectors which bring about pollination are not there. The Kokum or Garcinia indica grows at Matheran, Konkan and Ratnagiri hill tops where it grows well, and also Olea nilgirense, but it is not known to yield fruit from which edible oil could be extracted. The cultivation of Olea europea-European olive is done at some places like Ranchi, and it is reported to be successful. It is worth attempting. The cultivation of African Oil Palm (Elaeis guineensis), Cocos coronata of South America, Stereospermum oleifera is also worth trying in different regions of Konkan, especially where weather is hot and there is sufficient moisture in soil and, in air.

Palm as a whole is an important economic family, but not much attempt has been made for its cultivation. Cultivation of *Metroxylon sagu*, Sago Palm is possible in plains in Konkan, but it does not appear to have attracted attention of the botanists. Similarly, there are other plants of economic importance which possibly could be cultivated in different regions of the State.

Regarding the fibre yielding plants, not much can be said for want of any data. Plants such as Caryota, Boehmeria, Hibiscus and other wild fibre-yielding plants like Malachra capitata, Thespesia lampas need trials. Corchorus olitorius and C. capsularis were tried in South Ratnagiri and their cultivation was reported successful. Tapioca, the root of which is a staple food of the people in Kerala does well in many regions of Maharashtra. It needs plantation on large scale and trials to succeed industrially.

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10. HONEY AND HONEY BEE PLANTS

Honey is the sweet fluid collected from the Bee hives. It is stored by Apis mellifera, Apis cerana, Apis florea, Apis dorsata etc. from garden as well as wild flowers. There are three species of bees in Maharashtra and bee-keeping is a popular cottage industry in certain parts. The very common bee, from the hives of which the honey is generally collected, is Apis cerana belonging to the Order Hymenoptera of Insects. It is a medium size bee compared to Rock Bee, Apis dorsata which is large. The latter builds its hives in distant jungles, away from human habitation, attached to some high building, trees, boulders or rocks. It is easily provoked with the least disturbance and attacks any moving object nearby. There is a third bee. It is a very small bee A. florea

The common bee Apis cerana collects nectar from garden as well as wild plants generally in the hills and forests. There are large populations of these at Mahabaleshwar, Melghat, Sagar, North Kanara, Phonda Ghat, Kodaikanal, Ootakammund etc. The small bee A. florea is found in coastal regions. There is territorial distribution among the bees. They visit the same area and same flowers to collect the nectar from same plant species. The little bee A. florea occurs in tropical coastal plains.

Honey bees are polytropic, but once a source is selected at any time, they visit that source and exhibit constancy of 'floral fidelity', as long as those flowers last, ignoring other sources. It carries pollen in baskets on its legs and on its probacis. Due to its very hairy body it carries a large number of pollen grains when it visits a flower and then another to collect either pollen or nectar. It brings about cross pollination as it moves from flower to flower. A bee has instinctive capabilities to distinguish sources of food, and never makes a mistake. Honey bees rarely collect pollen poisonous to man or to themselves. They avoid such flowers. They also collect sugary fluid secreted by smut fungi like smut of Sorghum (Jowar), and secretions produced by aphids or from the cut end of sugarcane etc.

There are two flowering seasons for wild plants in Maharashtra and in India, one short season October-November and second a long one in period from March to June till the advent of rains. During the first part of Kharif season, bees visit the crop plants for their food and migrate in rainy season to drier areas. Thus they have developed the habit of migration to avoid starvation. On an average of 55 kg of honey is obtained from a hive in a year. Foragers or worker bees have to visit the flowers at least 100 million times to accumulate 1 kg of honey. On an average 3 mg of nectar is available from each flower.

As the different flowering plants come in blume at different times, it may appear difficult to find from which flowering plants the bees have gathered nectar. But the study of local flora helps in solving the problem. Examination of pollen grains of plants in the vicinity and those in the honey, is a practical method to identify the plants of the beesforager in a particular season. Nectar is collected generally from flowers but sometimes also from extra-floral nectaries as in species of Terminalia and cotton, etc.

Honey has many medicinal properties according to Ayurvedic and Allopathic systems. It is highly nutritious. In Ayurved a lot of properties of good and old honey are described.

The presence of nectar serves as a bait to pollinaters and probably helps the pollen tubes to germinate in ovary and style till the ovules are reached.

Since the bees live on flowers and nectar, they need a large amount of flora for pasturage. Many indigenous plants in the jungle, forests, in valleys serve as the main sources of bee pasturage. Many exotic plant species have also been introduced in the country for this purpose. Some of the important bee pasture plants in Maharashtra are given elsewhere in this book. Bees increase the yield of crop plants. It has been shown that by keeping bee-hive lines in crop field, the yield of seeds and fruits increases greatly. (See Deodikar and Suryanarayana, 1977, Advances in Pollen and Spore Research, 2: 263). Breeding of

bees, is now a special branch of Agriculture. The total production of honey in India is given in Khadi and Village Industries Commission Reports annually.

Many crop plants such as cotton, maize, mustard, bhendi, (Hibiscus esculentum) are important sources of bee pasturage in both Kharif and Rabi seasons, especially in Kharif season. Several fruit trees such as mango, oranges, limes, Lokat (Eriobotrya), citrus fruit trees also provide nectar. Some kinds of honey have good aroma, e. g. Rose honey of Mahabaleshwar.

Honey consists of 70-80 per cent dextrose and levulose, 20 per cent water and 1.4 per cent sucrose and other substances. It also contains a small amount of resinous material. Honey contains saturated sugars.

Since the bees live on nectar in flowers a large amount of flora is necessary for their pasturage. Many indigenous plants in forests are the main source of pasturage. It is, therefore, important that the bee pasturage trees be protected. Some exotic plants have also been introduced. Several plants in the gardens such as *Althea*, Antigonon, safflower, crucifers, beans, balsama, cabbage, raddish, linseed, mango, gulmohor, bombax are important sources for bees to collect nectar, besides wild plants.

List of plant sources of Bee pasturage—garden and wild—are given in subsequent pages.

With the establishment of the Central Bee Research Institute at Pune by the Maharashtra Village Industries Board, a large number of Bee Research Centres have been opened. The pollen is studied there to locate sources of honey and a co-ordinated programme of research is conducted under the auspices of Central Bee Research Institute at Pune. A separate journal is also run by them named as Indian Bee Journal. Some Research Laboratories are located at different hill stations. They run for nearly 9 months in a year, except in the months of rainy season. They have training centres for Honey and Apiary Management. Many plants suitable as Bee fodder for increased honey, indigenous as well as exotic, are cultivated. Regular studies on physico-chemical properties of honey from different plants, in different seasons, and places are carried out. The following Table No. IX-B-10.1 gives main physico chemical properties of honey gathered at Mahabaleshwar determined by Dr. Phadke, Director of the Central Bee Research Institute, Pune.

It will be realized from the above that Bee and Apiary Industry has a considerable scope in rural areas and in the hilly humid or semi-humid areas of Sahyadri and Satpudas.

PHYSICO-CHEMICAL COMPOSITION OF HONEY IN MAHABALESHWAR (AFTER P. R. PHADKE-Ind. Bee. Jour 24: 59-65, 1962) TABLE IX-B-10.1

	•					,					
S. No.	Floral source	ee	Karvi	Whayti	Karwi	Pisa	Burambi	Akhra	Jambul	Hirda	Gala
-	Moisture	:	18-33	19,11	18.25	19.30	18.86	19.57	18.15	17.13	16,09
7	Specific gravity	:	1.41	1.405	1.405	1.407	1.409	1.415	1.42	1.415	1,425
Э	Direct polarisation	:	2.18	-1.12	-0.54	-2.30	-1.48	-0.36	-1.48	-1.48	-2.12
4	Total dissolved slides	des	79.75	79.00	79.75	78.25	79.25	79.00	80-00	81.25	82.25
Ś	5 Total sugars	:	77.82	78.67	79.13	73,50	76.24	77.18	78.25	79.06	68-62
9	Non-reducing sugars.,	ars	11.36	0.55	3.36	4.06	4.80	1.80	? 4	3.70	2.08
7	Reducing sugars	:	66.46	78.12	75.77	69.44	71.44	75.38	75.81	75.36	77.80
∞	8 Levulose	:	38.29	39.80	41.19	35.71	39.12	40.18	39-72	41,30	42.54
6	9 Dextrose	;	28.17	38.32	54.58	33-73	32.27	35.20	36.09	34.06	35,36
10	10 Ratio L/D	•	1.36	1.08	1.19	1,06	171	1.14	1.10	1.21	1.20
11	11 Deatrins	:	2.14	1.08	0.50	1.98	1.37	1.58	1,15	1.49	1.89
12	Acidity	:	0.173	0.112	0.156	0.113	0.093	1.138	0.063	0.037	0,062
13	Ash	:	0.298	0.138	0.128	0.478	0.113	0.175	0.198	0.014	0.167
4	Proteins	:	0.817	0.579	0 29	1.135	0,389	0.546	0.485	0,61	0.417
15	Undetermined	:	1.92	1.89	2.00	2.38	1.39	1.43	1.85	1.62	1.66
16	Fiche's test	:	-ve	- ve	, Ve	-ve	-ve	i Ve	ve	-ve	ve
17	17 Colour	:	Greenish amber	Light yellow	Light yellow	Dark	Light	Light amber	Ambar	Light yellow	Pale yello _w

BEE FORAGE (WILD PLANTS)

	3 e*		77 1 20
Acacia sinuata (Lour) Meev	Mimosaceae	• •	FebMar.
A. nilotica (Linn) Del	Mimosaceae	• •	SeptJuly
Actinodaphne angustifolia Nees	Lauraceae		December
Aegle marmelos (L.) Corr	Rubiaceae		June
Ailanthus excelsa Roxb	Simarubeaceae		December
Azadirachta indica A. Juss	Meliaceae		MarApr.
Bombax ceiba L	Bombacaceae		JanMar.
Borassus flabellifer L	Araceae		December
Butea monosperma (Lamk) Taub	Papilionaceae		JanMar.
	C11		NovDec.
Calophyllum inophyllum L	Dullingian	• •	
Canthium parviflorum Lamk		• •	AprMay
Cassia fistula L	Caesalpincaceae	• •	May-June
Cennamomum zeylanicum Bl	Lauraceae	• •	DecJan.
Dalbergia sissoo Roxb	Popilionaceae	• •	FebJune
Dillenia pentatagyna Roxb	Dilleniaceae		MarApr.
Diospyros embryopteris and other	Ebenaceae	٠.	MarApr.
species.			-
Ehretia acuminata R. Br	Ehretiaceae		April
Elaeocarpus spp	Elaeocarpaceae		•
Emblica officinalis Gaerth	Euphrbiaceae		MarJune
Erythrinad indica Lamk	Papilionaceae		FebMar.
Flacourtia indica (Burm.f.) Meer	Flacourtiaceae	• •	FebMar.
	1 Ideo di naccao	• •	NovDec.
F. montana Grah	Durcaracana		MarJune
Garuga pinnata Roxb	Burseraceae	• •	MarJune
Grewia asiatica L.	Tiliaceae		7 17-1
Holigarna grahamii (Wt.) Hk.f	T 5 T 10 ST	• •	JanFeb.
Hopea wightiana W. & Arn	Dipterocarpaceae	• •	MarJune
Limonia acidossima L	Rutaceae	• •	FebMar.
Syzygium caryophyllatum (L.)	Myrtaceae		AprMay
Alston and S. cumins.	SH174 1		
S. zeylanicum (L.) DC			FebMar.
Lagerstroemia lanceolata Wall	Lythraceae		AprMay
Litsea stocksii HK. f.			OctNov.
20 1 1 1 0 1	Sapotaceae	••	January
Madhuca indica Gmei. Memecylon umbellatum Burm	Malestomaceae	• •	FebMar.
	Rubiaceae	• •	1 004-141411
	Rubiacac		
citrilolia L.	Oleaceae		FebMar.
Olea dioica Roxb.	Papilionaceae	• •	MarApr.
Pongamia pinnata (L.) Pierre	Verbenaceae		AprMay.
Premna coriacea Clarke	Rosaceae	• •	No vember
Prunus zeylanica (Wt.) Mig	Salicaceae		OctNov.
Salix tetrasperma Roxb.		• •	
Sapindus laurifolius Vahl	Sapindaceae	• •	May-June
Strychnos nux-unmica L.	Strychnaceae	••	MarApr.
Symplocos deddomei Clarke	Symplocaceae	• •	NovFeb.
Syzygium cumini (L.) Skeels	Myrtaceae	• •	MarApr.
Terminalia alata var. nepalensia	Combretaceae	• •	AprJune
Burm.			
T. arjuna Wt. and Arn	Combretaceae	• •	AprJune
T. bellerica (Gaertn.) Roxb	Combretaceae		AprJune
T. chebula Retz	Combretaceae		AprJune
Toona ciliata Roem	Meliaceae		AprJune
Vateria indica L	Dipterocarpaceae		AprJune
Xeromphis spinosa (Thumb.) Keay	Rubiaceae		AprJune
Zizyphus mauritiana Lamk	Rhamnaceae		OctNov.
Lieypius muuimum Lama			

Z. rugosa Lamk. .. Rhamnaceac Jan.-Mar. Asparagus racemossus var. Liliaceae

javanica Baker.

Cocos nucifera L. . . Palmae
Borassus flabellifer L. . . Palmae
Areca catechu L. . . Palmae
Arenga wightii . . Palmae

Ensete superbum Cheesemann.

Common Garden Plants as Bee Forage

Allium cepa L. Liliaceae Althea rosea Cav. Malvaceae Jan.-Dec. Antigonon leptopus Hk. and Arn. Polygonaceae .. July-Nov. .. Brassicaceae Brassica campestris L. Oct.-Dec. Cajanus cajan (L.) Mil. Papilionaceae ٠. Jan.-Feb. Carthamus tinctorius L. .. Asteraceae Jan.-Feb. Celosia argentea L. .. Amaranthaceae Mar.-Sept. Coriandrum sativum L. .. Apiaceae .. Sept.-Oct. Cosmos lupinatus Cav. .. Asteraceae Jan.-Oct. Iridaceae Crocus sativus L. Oct.-Nov. ٠. Cucumis sativa .. Cucurbitaceae ... Fagopyrum eculantum Moench. .. Polygonaceae October Faeniculum vulgare Mill. .. Apiaceae Gossypium spp. .. Malvaceae Mar.-Dec. Guizotia abyssinica Cass. .. Asteraceae .. October Helianthus annuus L. .. Asteraceae Jan.-Oct. H. dubius L. Sept.-Oct. Impatiens balsamina L. and other Balsaminaceae ... Oct.-Nov. spp. Ipomea learii Roxb. Convolulaceae ... Oct.-Nov. Linaceae ... Linum usitatissimum L. . February Musa paradisica L. Musaceae .. Musaceae .. Jan.-Dec.
Lamiaceae .. Oct.-Nov. Origanum vulgare L. .. Papaveraceae .. Papaver spp. Feb.-Nov. Pennisetum typhoides (Burn.) .. Poaceae July-Dec. Stapf. and Hubb. Phlox drummondii Hk. f. .. Polymoniaceae .. Feb.-Dec. .. Portulacaceae .. June-Oct. Portulaca grandiflora Hr.

Besides these, the following wild and cultivated plants serve as a source of nectar:

Atalantia racemosa Lamk.

Barleria sp.

Various lilies

Palms particularly Cocos, Areca, Borassus and Sabal.

Roses

Hissopus and members of Labiateae

Vitex negundo Linn.

T. erminalia bellirica (Gaertn.) Roxb.

T. arjuna t. and Arn.

T. chebula, Rotz.

Tecomela undulata (Smith) Spach.

Zizyphus jujuba

Z. mauritiana Lamk.

Bauhinia racemosa Lamk.

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C. PLANTS OF SPECIAL HABITATS AND HABITS

11. DROUGHT RESISTANT PLANTS IN DECCAN

In the years 1917-18 there was no rain at all in Ahmednagar district and in parts of Marathwada. This resulted in complete drought and famine in this area. As a consequence of it all the wells, rivers, canals dried up. Water at the surface and underground got completely evaporated. Soil developed large cracks in the sticky black cotton soil. Inspite of this, some drought resisting plants did survive and sprouted after scanty rains that came in the third year. These plants were studied by Shri R. K. Bhide 1921, J. Ind. Bot. Soc. 26 and 27: 27-43, and listed with their xeromorphic peculiarities. Similar conditions are also often noticeable in the desert plants of Rajasthan.

Drought resistance in plants develops physiological mechanism C4 to C3 mode of photosynthesis. A critical examination of these plants has shown that many of them have C3 mechanism. C4 plants in the area are very few. Prof. G. V. Joshi has scanned the list given below to know which of these belong to C3 and which to C4. Some apparently behave like succulents changing their photosynthetic mechanism from C3 to C4. The development of the drought resistance is generated in them by the physiological conditions like those in mangroves and succulents.

The abovementioned drought in Bombay Deccan lasted over 1917 to 1919. It was very severe and long. Usually the normal rainfall over most of the area of Bombay Deccan is 15 to 30 inches per annum. But in those years, it was actually 1/3rd to 1/2. In 1918 wild plants in monsoon did not grow well. Even the most resistant plants like Acacia arabica, Ficus bengalensis and Opuntia nigricans got dried up.

Shri Bhide tried to ascertain what plants actually remained alive next year after such a long drought and what amount of moisture was available to their root system and general behaviour of these plants and their adaptations.

It was found that there was only 3-3.5 per cent moisture in soil around the roots of some dried plants. Their size and number were reduced. Plants with prostrate habit reduced their leaves and branches e.g., Polygonum plebejum, Chrozophora prostrata, Solanum xanthocarpum, Argemone mexicana dried completely. On the other hand, Euphorbia neriifolia, Salmalia malabarica, Opuntia nigricans, Gymnosporia rothiana, Fluggea leucopyron, Lantana camara, Vitis woodrowii, Acacia arabica, shed their leaves completely. Plants at Belapur had dried roots but not entirely. Newasa, Shevgaon, Pathardi, Ahmednagar had still lower water content in the soil around the roots of plants, only 0.80 to 3.93 percent. Some developed leafy bracts, rough hairs, short woody roots hardly 1 to 2 inches long e.g.. Leptadenia prostrata which normally has 10 inches long roots. The shape of leaf in many of them was changed in Lepidagathis trinervis, Tephrosia purpurea, Cocculus villosus, Morinda tinctoria, and in many others. Very few grasses survived. But in them. Andropogon developed tufted perennial fibrous roots.

Even trees like Feronia elephantum, Ailanthus excelsa, Butea monosperma, Tamariandus indica, Ehretia aspera, Vitex negundo, Ficus retusa, Phoenix sylvestris had parched leaves. Some became leafless e.g., the shrubs of Capparis divaricata, Rhus mysorensis, climbers like Vitis pallida, Rivea hypoercrateriformis, Tribulus terestris. They

practically were leafless. Only the underground parts of *Ischaemum pilosum*, *Andropogon pertusa*, *A. annulatas*, *Cynodon dactyoln* remained. During the hottest part of the year, the amount of moisture became so less that it was only 1.4-2 per cent in clayey soils. In gravely soils and in deep black cotton soil it was 3-4 per cent. A general reduction in the size of aerial parts of plants, leaves and branches, was there. Tap roots in all these plants were highly characteristic. They had strong, woody underground system which enabled them to survive under these extreme xeric conditions. The small xerophytic shrubs and herbs did not regenerate. The worst had happened in Maharashtra during the Durgadevi famine.

Maharashtra as a whole is semi-arid region, barring Konkan and parts adjacent to Sahyadris. Therefore, any failure of rains or shortfall, creates conditions of aridity such as those described by Bhide. Drought resisting plants and dry deciduous forests only survive, and have been in existence in Maharashtra since the sub-recent period, probably earlier upto Miocene at least.

List of drought resisting plants is given below.

Drought resisting plants in the Deccan

Species					Photosynthetic mechanism*
Polygonum plebejum R. Br.	6522		g.		C3
Chrozophora prostrata Dalz.	Y	Y21 19			C3
Solanum xanthocarpum Schl.	Y /3	11 11 11 11			Č3
Argemone mexicana L.	.1.22	4 800 3			C3
Euphorbia neriifolia L		AL TOTAL	38.		C3
Bombay malabaricum DC.	P. L.	20017	47.0		**
Opuntia nigricans Haw.			3/6		C3
Gymnosporia rothiana Laws.					
Fluggea leucopyrus Willd.	सन्ध	मेव जय-	7		• •
Lantana indica Roxb					••
Vitis woodrowii Stapf					Ċ3
Acacia arabica Willd					C3
Lepidagathis trinervis Nees					Č3
Tephrosia purpurea Pers.s	• •	•••			C3
Zizyphus xylopyra Willd.					C3
Tragia cannabina L.:		• • •		• •	CJ
Echinops echinatus Roxb.			••	•	••
Leptadennia reticulata W. and	À.			• •	• •
Cucumis trigonus Roxb.				• •	: 3
Tridax procumbens L		• •	••	• •	CJ
Vernonia cinerea Lam				• •	• • •
Cocculus villosus DC	***		••		6 10
Morinda tinctorea Roxb.				• •	♦ 14
Heliotropium supinum L.				• •	• •
Alysicarpus rugosus DC.				••	.; C3
Trichodesma indicum R. Br.	• •	••	•••	••	C3
Celosia argentea L			••	••	C3
	•			••	CS

^{*}I owe this information to Dr. G. V. Joshi of Shivaji University of Kolhapur who expired recently.

^{**} not available.

				_	
		Spec	ies		Photosynthetic mechanism
Heliotropium zeylanicum L	am.	• •		••	C4
Taverniera nummularia DC.					
Citrullus colocynthus Schrad					Ċ3
Balanites roxburghii Plauch				• •	• •
Trianthema pentandra L.					
Boerhaavia diffusa L				.,	C4
Dipcadi montanum Dalz.					C3
Cyathocline lyrata Cass.		• •			
Andropogon monticola Schu	ltz	••	• •	• •	C4
	,	Trees			
Feronia elephantum Cor.					C3
Ailanthus excelsa Roxb.				• •	C3
Melia azadirachta L			• •		C3
Mangifera indica L		• •			C3
Butea monosperma (Lam.)	Taub.			• •	C3
Cassia fistula L					C3
Tamarındus indica L	. 5	The state of			C3
Parkinsonia aculeata L.	500	3875	O-1		C3
Acacia arabica Willd	2503		953		C3
Prosopis spicigera L			(62)		C3
Diospyros memellanoxylon 1	Roxb.	12:00	63		C3
Salvadora oleoides Dene.	6000		89		C4
Ehretia aspera Roxb	TI	THE			
Vitex negundo L	17/2	9 V.A. 9			C3
Euphorbia tirucalli L	18	4 84	b		C3
Bridelia retusa Spr	A115		35.		4.4
Ficus bengalensis L	125.49		6.9		C 3
F. retusa L	(CHEE)		200		C3
Phoenix sylvestris Roxb.	सरा	मेव जय		••	••
		Shrubs	-1		
Capparis aphylla Roth					C3
C. divaricata Lam	••	••	••		C3
Cadaba indica Lam		••			C3
Gymnosporia rothiana Laws	••	••			C3
Rhus mysorensis Heyne		••	• •		C3
Cassia auriculata L					C3
Mimosa hamata Willd.					Č3
Dichrostachys cinerea W. an	dÄ.				C3
Opuntia nigricans Haw.		• •			ČAM
Calotropis procera R. Br.	••				C3
Jatropha curcas L				••	•••
Fluggea leueopyris Dalz.	•••			••	••
Agave vivipara Wight	••	••	•••	••	CAM
	Climb	ing shr	ubs		
Vitis pallida W. and A.	••				C3
Gymnema sylvestre R. Br.	•••	••			C3
Cryptostegia grandiflora R.		••	• •	••	C3
Rivea hypocrateriformis Cho	isv				Č4
THING INTEREST OF THE PARTY OF THE	- 5			• •	~ ,

	5	Species			
Her	Photosynthetic mechanism				
Cleome viscosa L. Polygala erioptera DC.	••	••	***	***	C ::-
Triumfetta rotundifolia Lam. Tribulus terrestris L.	• •	••	***	474	C3 C4
Indigofera cordifolia Heyne	••	***	***	***	C3
Corchorus antichorus Raens	• •	• •	*44	424	C3
Blumea malcolmii HK Vicoa auriculata Cass	••	•:•	*10	***	•
Flaveria contrayerba Pers. Evolvulus alsinoides L Lippia nodiflora Mich	• •	••	•••	***	•••
	• •	••	• •	***	C4
Achyranthus aspera L.:	• •	••	•••	••	C3 C4
Aerua javanica Juss Aristolochia bracteata Retz.	••	••	••	• •	C3
	•-•	• •	••	• •	* *
	G	rasses			
Pennisetum alopecuros Nees.	pr 53	THE STATE OF		*10	C4
Ischaemum pilossus Hock.	***		23.	4.0	C4
Andropogon pertusus Willd. Andropogon annulatus Forsk.				*14	C4 C4
Cynodon dactylon Pers.	•.•		3	***	C4

12. SUCCULENT PLANTS

These are found growing in xeric conditions. They are characterised by their fleshy nature either of leaves, stems or of both. Generally they have spines as defensive structures. Many of them are found in the desert regions of the world e.g., Cacti. Maharashtra though not a desert, is considered semi-arid in many parts. The succulents and drought resistant plants that grow there are not all true xerophytes; they only wear xerophytic mask and show xeromorphic features. It is difficult to draw a line between semi-desert and arid desert xeromorphic plants.

It is believed that all desert plants have water saving and storing devices such as reduction of leaf surface to reduce transpiration, sunken stomata, water storage tissue, thick cuticle or epidermis multiple hypodermis etc. Some desert plants and succulents have water absorbing and storing roots, contractile roots, tuberous roots and stem. Deep laid roots, superficial fibrous roots, deep set large tap root; and above all effecient photosynthetic mechanism. Their epidermis and cuticle is often covered with wax and profuse hairs. Many of them have Crassulean photosynthetic cycle and some have CAM system. All these adaptations make them efficient for surviving in hot desert regions. They have elaborate arrangements for food storage.

There are two types of succulents: those with leaves and those without leaves. Some of them are physical xerophytes and some physiological xerophytes e.g., Mangroves are considered to be physiological xerophytes. Cacti are true xerophytes. On the top of Himalayas there are fleshy plants which also suffer from physiological inability to have water due of formation of ice crystals in their tissues. They become succulent. They have thick cuticle and profuse hairs developed during winter.

As a rule xerophytes—true or apparent—have large tap roots deep below the soil or sand. There is good Cactus section in Lal Bagh Garden, Bangalore; National Botanical Garden, Lucknow; and at the Late Maharaja's Palace at Saitala near Ratlam:—

List of important Succulent Plants in Maharash(ra with fleshy leaves on stem

Portulaca species Vitis quadrangularis Wall. V. setosa Wall. V. longata Wall. Bryophyllum laciniosa Naud. Kalanchoe bhidei Cooke K. floribunda W. and A. K. glandulosa Hochst. K. laciniata DC. K. spathulata DC. Begonia concanensis DC. B. crenata Dryand B. malabarica Roxb. B. minima Bedd. B. roxburghii DC. B. trichocarpa Dalz. Trianthema monogyna L. Anotis quadrilocularis Hk. f. Notonia grandiflora DC. Caesulia axillaris Roxb. Periploca aphylla Dcne. Sarcostemma brevistigma Wt. S. stocksii Hk. f. Tylophora tenuis Bl. Hoya carnosa Br. Ceropegia acuminata Grah. C. angustifolia Dalz. C. attenuata Hk. C. bulbosa Roxb. *Frerea indica* Dal**z.** Caralluma fimbriata Wall. C. edulis Bth. Salvadora persica L. S. oleoides Done. Heliotropium indicum L. *Ipomoea biloba* Forsk. Herpestis monniera H. B. and K. Limnophylla concerta Bth. L. gratissima L. heterophylla Woodr. L. polystachya Bth. Leptadenia spartinum Wt. Clerodendron inerme Gaertn. Piper longum L. Peperomia pellucida H. B. and K. P. portulacoides Dalz. P, wightiana Miq. Cassytha filiformis L Loranthus wallichianus Schultes

L. scurrula Linn.

L. gibbosus Talbot.

L. cuneatus Heyne.

L. longiflorus Desrouss.

L. lageniferus Wight

Viscum orientale Willd.

V. angulatum Heyne.

V. articulatum Burm.

Euphorbia acaulis Roxb.

E. antiquorum L.

E. clarkeana Hk.

E. coccinea Roth.

E. crithroclada Boiss.

E. glauca Roxb.

E. granulata Forsk.

E. heterophylla L.

E. ligularia Roxb.

E. microphylla Heyne.

E. neriifolia Dalz.

E. nivulia B. Ham.

E. parviflora L.

E. prostrata Grah.

E. pulcherrima Willd.

E, rosea Retz

E. rothiana Spr.

E. splendens Boj.

E. tirucalli L.

E. tithymaloides L.

E. uniflora Dalz.

Pilea microphylla Liebm.

Habenaria affinis Don.

H. candida Dalz.

H. commelinifolia Wall.

H. crassifolia Rich.

H. digitata Lindl.

H. diphylla Dalz.

H. foliosa Rich.

H. gibsoni Hk.

H. gigantea Don.

H. laciniata Dalz.

H. lawii Hk.

H. longecalcarata Rich.

H. marginata Coleb.

H. modesta Dalz.

H. platyphylla Spr.

H. rariflora Rich.

H. rotundifolia Lindl.

H. schizochilus Grah.

H. stocksii Hk.

H. uniflora Dalz.

H. viridiflora Br.

H. wightii Trim.

Agave americana L.

A. cantala Roxb.

A. rigida var. sisalana Woodr.

A. vivipara

A. vera-cruz Mill.

Dipiadi concanense Dalz.

D. minor Hk. f.

D. montanum Dalz.
Pedalium murex L.
Cleome aspera Koen.
C. cheliidonii L. f.
C. monophylla L.
C. vahliana Fees.
Capparis aphylla Roth.
Flacourtia latifolia Cooke
Leea macrophylla Roxb.
Sansevieria cylindriea Boj.
S. variagata

13. AQUATIC ANGIOSPERMS AND PTERIDOPHYTES

Some angiosperms and Pteridophytes grow in water. They form roots in the substrate mud and throw up their leaves, flowers and fruits or sporophylls, spore producing parts, spores on the surface of water e.g., Nymphaea alba., Limnanthemum indicum (now recognised as L. numphoides). Equisetum etc. Some others remain always submerged and their flowers come to the surface of water only at the time of fertilization e.g., Vallisneria, Blyxa, Lageresiphon, and again they go back and live below water. Still others grow only at the subsurface of the water but do not root in the substrata e.g. Lemna, Wolffia, Pistia. The fourth category is of those whose spores and seeds germinate in mud, and plants that sprout grow in shallow water. Others grow at the margin of the pond. They live partly as aquatic plants for some time and later lead a terrestrial life, e.g., in Isoetes some species are fully submerged and some half-submerged and some terrestrial.

An aquatic plant is one which needs presence of water to grow and to complete its life cycle. It must have some part of its life cycle in water or with its help.

Most of the water plants are very well adapted to aquatic existence. They have stomata on the upper surface of leaf while some have none. The exact number of aquatic plants is not known. They have been described by various workers (Agharkar, 1923; Biswas and Calder, 1953; Mirashi, 1954-1975; K. Subramanyam, 1962). Subramanyam has described 117 taxa of aquatic angiosperms spread over 32 families. In Maharashtra a large number of them occur in lakes at Umred, Khandala, Katyani Rankala and Kagal near Kolhapur, and also in isolated lakes at high altitude at hillstations like Panchgani, Mahabaleshwar and Khindsi (Ramtek).

Many water plants are common all over India due to their specific similar requirements, except the members of the Podostemaceae growing in fast moving streams at high altitude places like Khandala or Mahabaleshwar in Western Ghats and at Cherrapunji in Meghalaya. The representative of Pteridophytes are Equisetum, Isoetes and species of water ferns like Marsilea, Azolla, Salvinia (which is not found in Maharashtra), and Ceratopteris thalictroides. The last fern may occur as a floating aquatic or may grow on wet mud at the lake margin. Similarly Acrostichum aureum may grow amphibiously or in brackish marine water at Goa.

The late Prof. M. V. Mirashi has described physiological anatomy of a number of water plants around Nagpur and his work is considered important, particularly on Cyperaceae, Compositae etc. Some water plants were earlier described by Prof. J. F. R. D'Almeida also.

The list given below excludes marine water plants like Enhalus or Halophila since they are grouped with plants in mangrove swamps. They have been treated elsewhere. The list below does not claim to be exhaustive:

List of Common Aupatic Angiosperms in Maharashtra

[After Cooke (1908), K. Subramanyam (1962-1978), Nagendran, Blasco (1971), and others]

Nagendian, b	nasco	(19/1),	, am	dothers
			1	Flowering period
Ranunculaceae : Ranunculus aquatilis Ranunculus seperatus				
Nymphaeaceae: Nymphaea stellata Willd. Nymphaea nouchali Burm. Euryale ferox Salisb. Nelumbo nucifera Gaertn.		•••	***	Throughout year Throughout year Cultivated Before and after rains
Cruciferae: Nasturtium officinale R. Br.			-	
Elatinaceae: Elatine triandra Schk. Bergia capensis L			2	July Sept-Jan.
Balsaminaceae: Hydrocera triflora (L.) W	t, and	Arn.		
Leguminosae:		TIY		
Papilionoideae: Aeschynomene indica L. Aeschynomene aspera L.			***	Throughout year In winter
Mimosoideae: Neptunia oleracea Lour.			***	Monsoon and winter
Myriophyllum tuberculatum Myriophyllum spathulatum Hallb.	Roxb. Blatt. a	·)	=1.0	Throughout year at Khandala, Mahabale-shwar.
Myriophyllum spicatum L. Myriophyllum intermedium Myriophyllum indicum Wilk Myriophyllum verticillatum	d .	• •	• • •	Jun-Dec. Throughout year Jun-Aug.
Callitrichaceae: Callitriche stagnalis Scop.				Feb.
Onagraceae: Jussiaea repens L J. suffruticosa Ludwigia parviflora	*1.0 *1.0	61.0 646 8-0	***	Oct-Jun Sept-May
Trapaceae: Trapa bispinosa Roxb.	. :•			Rainy season
Gentianaceae: Nymphoides cristatum (Ros O. Kuntze. Nymphoides indicum (L.) (Nymphoides aurantiacum (I O. Kuntze.). Kun	itze.	***	Nov-Mar. Nov-Dec.

Numphoides parvifolium (Griseb). O. Kuntze.	••	Nov-Dec.
Hydrophyllaceae: Hydrolea zeylanica	••	
Convolvulaceae: Ipomoea aquatica Forsk.	••	NovMar.
Scrophulariaceae: Limnophila rugosa (Roth) Merrill. Limnophila aromatica (Lamk.) Merrill. Limnophila heterophylla Benth. Limnophila aquatica (Willd.) Santapau. Limnophila indica (L.) Druce Dopatrium junceum (Roxb.) Buch-Ham Dopatrium lobelioides (Retz.) Benth. Lentibulariaceae: Utricularia stellaris L. Utricularia flexuosa Vahl. Utricularia exoleta R. Br. canthaceae:		SeptOct. JunJan. SeptDec. DecMar. Rainy and cold seasons Rainy and cold seasons SeptJan. Rainy season OctFeb.
Cardanthera difformis Druce. Asteracantha longifolia (L.) Nees	2.	OctFeb.
Amaranthaceae: Alternanthera sessilis (L.) DC. Polygonaceae Polygonum orientale L. Polygonium pulchrum Bl. Polygonum glabrum Willd. Polygonum barbatum L.		Throughout year Rainy season
Podostemaceae: Indotristicha ramosissima (Wt.) Terniola zeylanica (Gardn.) Tul. Terniola zeylanica Tul. var. konkanica (Willis) Santapau Dicraea dichotoma Tul. Dicraea stylosa Wt. Hydrobryopsis sessile (Willis) Engl. Griffithella hookeriana (Tul.) Warm. Willisia selaginoides (Bedd.) Warm. Farmeria indica Willis Zeylanidium olivaceum (Gardn.) Engl. Zeylanidium johnsonii (Wt.) Engl. Zeylanidium lichenoides (Kurz.) Engl. Zeylanidium lichenoides (Kurz.) Engl. var. khandalense (Willis) Santapau Zeylanidium lichenoides (Kurz.) Engl. var. bhorense (Willis) Santapau Podostemon subulatus Gardn. Podostemon barberi Willis		JanFeb.
Ceratophyllaceae: Ceratophyllum demersum L.	-	JanMar.
Hydrocharitaceae: Hydrilla verticillata (L. f.) Royle Nechmandra alternifolia (Roxb.) Thw. Vallism ria spiralis L. Blyxa auberti Rich.		OctJan. OctFeb. OctMar. DecJan.

Blyxa echinosperma (Clarke) Hook. Blyxa octandra (Roxb.) Planch. Hydrocharis dubia (Bl.) Blacker. Ottelia alismoides (L.) Pers. Halophila ovalis (R. Br.) Hook. Enhalus acoroides (L. f.) Rich. Lageresiphon Roxburghi Benth.	DecFeb. DecJan. NovDec. SeptOct.
Pontederiaceae: Monochoria hastata (L.) Solms in DC. Monochoria vaginalis (Brum. f.) Presl. Eichornia crassipes (Mart.) Solms in DC.	Rainy season
Typha angustata Bory and Chaub.	
Araceae: Pistia stratiotes L Cryptocoryne retrospiralis Fisch.	Hot season
Lemnaceae: Spirodela polyrhiza (L.) Schleid. Lemna paucicostata Hegelm. Wolffia arhiza (L.) Wimm.	FebApr. May-Jan. JunOct.
Alismataceae: Caldesia parnassifolia Parl. Caldesia oligococca Buchen. Limnophyton obtusifolium (L.) Miq. Sagittaria sagittifolia L. Sagittaria guayanensis H. B. K. ssp. lappula Bogin.	May-Sept. JunOct. AprAug. FebMay AugNov.
Buto maceae:	
Tenggocharis latifolia (D. Don) Buchen.	NovMar.
	NovMar. Throughout year July-Dec. JanJuly Throughout year Throughout year Throughout year JanMay FebJune
Tenggocharis latifolia (D. Don) Buchen. Aponogeton aceae: Aponogeton natans (L.) Engl. and Krause Aponogeton crispum Thunb. Potamogeton nodosus Poir. Potamogeton octandrus Poir. Potamogeton perfoliatus L. Potamogeton pectinatus L. Ruppia maritima L. Zannichellia palustris L. Cymodocea rotundata Aschers and Schw. Cymodocea (R. Br.) Aschers. Cymodocea isoetifolia Aschers. Diplanthera uninervis (Forsk.) Aschers. Najadaceae: Najas graminea Del. Najas graminea Del. var. minor Najas indica (Willd) Cham.	Throughout year July-Dec. JanJuly Throughout year Throughout year Throughout year JanMay FebJune MarSept.
Tenggocharis latifolia (D. Don) Buchen. Aponogeton aceae: Aponogeton natans (L.) Engl. and Krause Aponogeton crispum Thunb. Potamogeton nodosus Poir. Potamogeton octandrus Poir. Potamogeton perfoliatus L. Potamogeton pectinatus L. Ruppia maritima L. Zannichellia palustris L. Cymodocea rotundata Aschers and Schw. Cymodocea (R. Br.) Aschers. Cymodocea isoetifolia Aschers. Diplanthera uninervis (Forsk.) Aschers. Najadaceae: Najas graminea Del. Najas graminea Del. var. minor	Throughout year July-Dec. JanJuly Throughout year Throughout year Throughout year JanMay FebJune

Xvridaceae:

Xyris indica L.

Cvperaceae:

Cyperus cephalotes Vahl. May-Jan. Cyperus platystylis R. Br. May-Jan.

Cyperus articulatus L. Throughout year *** Cyperus corymbosus Rottb. Throughout year

Scirpus grossus L. Aug -Dec. Scirpus articulatus L. Jan.-May

Scirpus kysoor

Besides these species of Kyllinga. Eleocharis occur in some ponds.

Gramineae:

Coix aguatica Roxb. Sept.-Nov. Paspalidium geminatum (Forsk) Stabf. Throughout year Pseudoraphis spinescens (R. Br.) Vickery Throughout year Leersia hexandra Sw. Throughout year Hygroryza aristata (Retz.) Nees Oct.-Apr.

N. B.—This list excludes plants of salt marshes such as Sueda maritima, Orthoenemum indicum, Salicornia, Artiplex species (see also list of mangroves.)

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14. ISLANDS IN THE ARABIAN SEA AND THEIR FLORA.

There are more than 100 islands in Arabian sea all along the West Coast of India, lying at variable distance from it. They are of different size and are important from the view points of defence, cil and gas resources, commerce and sea traffic. They occur in two subgroups on Maharashtra coast. Important of them are as below:—

- (A) Bombay sub-group—consisting of 7 islands.
- (B) Malvan sub-group—6 islands.

- (A) The Bombay sub-group (18°.55' N, 72°.54'E.)-
 - 1. Elephanta Island or Gharapuri [famous for c:
 - 2. Butcher's Island
 - 3. Armoury Island
 - 4. Nhava Island
 - 5. Manori Island
 - 6. Sheva Island
 - 7. Madh Island
- (B) Malvan sub-group (16°.3'N, 73°.28'E)—
 - 8. Kawade Bakal
 - 9. Devatara
 - 10. Padamgad
 - 11. Sindhudurg
 - 12. Vengurla Oyster Rocks
 - 13. Redi Fort.

Of these, the plants of Elephanta Island have been recently surveyed by Dr. A. G. Untawale of the National Oceanographic Institute, Goa. Plants of Madh Island have been collected by Dr. G. G. Shah and recently by Untawale. The latter botanist has also surveyed islands in the Arabian sea along the coast of Gujarat, Saurashtra, Goa and Malabar.

The flora of these islands is in no way different from that on the main land of Maharashtra facing them. It is in no way insular. The flora is of the monsoon dry or moist deciduous type. They are fringed or encircled by mangrove vegetation which is the same as on the west coast of India, in sticky mud flats all around. They appear to have arisen in not very distant past and have similar flora as on the mainland opposite them.

15. FLORA OF MOUNTAIN TOPS, GHATS AND ENDEMICS

Throughout Western India, there are small passes or ghats going down from heights of Sahyadris to Konkan. They are also present on the Desh side starting from hill tops to plains down below e.g., Kannad ghat near Aurangabad going to Ajantha and Chalisgaon, or Melghat in Amaravati district, Nandurbar ghat going down to Surat from Amalner. There is continuous erosion of the mountain slopes and top flats. account of this there is hardly any soil, 2"-3" on top of the mountains. and the plants growing there are very much stunted trees, bushes, a few herbs and grass. But on the middle slopes of ghats, in valleys and ravines at lower levels, there is good vegetation. Vegetation on the top contains a few trees of Tectona grandis, at places Bridelia retusa, Ailanthus excelsa. Hydnocarpus wightiana, Terminalia species, Memecylon Syzygium cumini, Atlantia racemosa, Sterculia guttata depending upon the altitude, rainfall and situation. Here one notices Leea macrocarphyla, If the rain is more Lagerstroemea lance-Gymnosporia montana. olata, if less Flacourtia ramontia, are seen. On several hill tops at the highest level, one sees in the crevices of rocks Begonia, Delphinium, senecio, Smithia species and some temperate herbs. Since the dry season here lasts for 7-8 months species like Elaeocarpus are found only on the

lower slopes. Mostly there are deciduous species as they withstand the drought period well e.g., Terminalia tomentosa, Anogeissus latifolia. On the lower-most slopes and in ravines small leaved evergreen species are seen e.g., Garcinia indica or Macaranga peltata.

The climate of Maharashtra and Deccan in general is dominated by the SW monsoons and dry continental winds in winter. In summer, it is hot and dry. The rainfall for the last 100 years at least has not shown any trend to increase or decrease than what it is at present. However, there seems to have had changes during Miocene-Pleistocene, in arid Miocene, and in cold Pleistocene periods, but these changes hardly affected radically the stratigraphy, geomorphology or the pattern of vegetation. It has remained nearly similar through Quaternary. Of course there were some short or long spells of humid climate and equally drastic spells of arid climate. This resulted in some species getting extinct, others migrating from their original locations to other areas. Some disappeared altogether from Maharashtra and Deccan e.g., Enigmocarpon and Nypa.

Recently Dr. R. S. Rao (1978) has studied the flora and floristic patterns along the lengthwise axis of Sahyadris at several places from Surgana bordering on South Gujarat to Agumbe in Coorg in Karnatak. He has given a full account of trees, bushes and shrubs at different places and altitude in the western ghats. It was noticed that more humid species like Litsea, Hopea, Dipterocarpus from Malabar flora come upto Amboli ghat via Goa, but they completely disappear from Sahyadri ranges further north; on the other hand, dry deciduous species from the North Sahyadris increase in number in Sindhudurg district. Paradoxically enough, as Rao has pointed out, side by side with heavy rainfall areas having evergreen or semi-evergreen forests in the lap of Sahyadris, there are also arid zones to the east of Sahyadris on Desh side where sparse deciduous forests, scrub or open grasslands occur. This contrast is explained on the basis of climate, rainfall, lack of humidity and soil in those regions, nature of soil and ratio of drought period to humid period. But even then this cannot be explained only on the basis of climate. rainfall or soil. In Assam also a similar situation exists where Dipterocarps both living and fossil occur on poor soil. This has much to do therefore, not only with climate and soil, but also with the past history of the flora and vegetation in those regions.

From the heights of high ranges of Sahyadris down to plains we get almost vertical sections of the Sahyadri ranges and vegetation at several places, from 1400 m high, down to plains 30 or 50 m. As we go down the ghats, or climb them up, change in the vegetation becomes apparent. At the highest level there are either depauperated deciduous forests, grass and discontinuous pockets of tropical semi-evergreen species on the Desh side at different levels in valleys, and in Mavals, in the vegetation of Dev Raics. The vegetation in high rainfall areas essentially consists of small leaved evergreen or semi-evergreen species e.g., Cinnamomum tamala, Garcinia indica, Actinodaphne hookeri, Litsea serrulata etc. But more interesting vegetation is seen in the middle of the ghats which is a conservatory of various groups of plants that come down from top levels e.g., Syzygium cumuni, Symplocos beddomei, Terminalia chebula, of some rare and endemic plants, fungi, liverworts, mosses and ferns. On the lowest level there is a zone of bushes consisting of strands of gregarious Nilgirianthes reticulatus, Carvia callosa, Barleria involucrata, Carrisa congesta, Holarrhena antidysenterica, Calycopteris floribunda etc.

But there are also large areas in the Sahyadris where only grass, a few shrubs and spiny trees like Xeromphis spinosa or Euphorbia neriifolia and some woody climbers grow. Although this is paradoxical the situation seems to have arisen due to historical changes in terrain, in addition to changes due to climate and soil erosion.

Dr. R. S. Rao (1978) has shown that there is variation in vegetation from Surgana to Coorg ghat and in species as one goes from north to south correlated with climate. There are evergreen forest trees under humid conditions in North Kanara, Mercara and further down in Malabar. Deciduous type of vegetation is seen throughout on the slopes of Sahyadris (300-800 m altitude). Tall evergreen forests occur in Shimoga and Coorg (700 and 900 m altitude). On the higher slopes and tops of Sahyadris (800-1500 m altitude) only stunted trees, scrub, and sparse pockets of semi-evergreen forests are seen. From Phonda-Amboli further south semi-evergreen vegetation gives way to tall semi-evergreen or evergreen forests in Agumbe and Mercara ghats. They are full of tall tropical trees and also the Sholas. Due to semi-arid climate throughout Maharashtra and low humidity, the canopy of tropical trees, even in Mahabaleshwar ghats, is not much impressive being formed by Syzygium, Calophyllum, Canarium, Mammea. These plants begin to appear from Phonda-Amboli ghat, Goa ghats and Braganza ghats. become denser in ghats of Karnatak. The rainfall in Western ghats being for a short period, the vegetation even of evergreen forests is not so thick as in the forests of Eastern ghats where rainfall and humidity are better distributed throughout the year, and last for a much longer period. In the Western ghats total rainfall is more but the leaching of soil is also more. According to Lagris and Meher Homji (1973), it is not only the total amount of precipitation but also the relative proportion of dry drought period to moist season is important for vegetation, because long dry period affects vegetation considerably.

Rao (1978) has enlisted typical species found in each of the ghats from Dangs to Mercara, on the lower and upper slopes of Sahyadri ranges in different ghats from north to south and has noted the floristic-patterns of vegetation. Broad-leaved species occur in abundance in Karnatak ghat forests. They are mixed with small leaved tropical species in Goa and Sindhudurg. Dry deciduous species occur mostly in northern Sahyadri ghats beyond Sawantwadi.

He has also pointed out that there are more than 100 endemic species in western ghats. Prominent among them are Frerea indica, Senecio hewrensis, Iphigenia stellata, Dicanthium panchganiense, D, mccannii, Pancratium santamariae, Arisaema caudatum, Bhidea burnsiana, Belosynapsis kewensis, Euphorbia erythroclada, Habenaria sp. Presence of endemic plants gives character to the flora of places.

16. MONSOON EPHEMERAL FLORA

The greater part of Maharashtra depends on South-West monsoons for rains, barring a few places like Bhandara, Chandrapur etc. in Vidarbha. The monsoons being a periodical phenomenon the flora also responds to them by producing plants and flushes of flowers periodically. A very remarkable flora of this nature appears more on the hill tops during midmonsoon months. It springs suddenly, completes its life cycle, disperses seeds and disappears. It is extremely spectacular after the midmonsoon months. The tuberous Liliaceae Scitamineae, terrestrial orchids, Compositae, Commelinaceae spring up suddenly and also the

colourful Leguminosae like Smithia species. About 225 such ephemeral plants are known and many of them have already been described in various chapters before. The whole list therefore is not repeated here. Monsoon Ephemeral flora is a special remarkable feature of the mountain flora of Maharashtra.

17. DEV RAIES OR SACRED GROVES

All along the Western Ghats there are small enclaves of semi-evergreen trees or groves of a few evergreen plants around the temple of a local deity. Under the fear of deity people are for bidden to cut any tree or shrub or grass there. The groves thereby get preserved and plants conserved. Attention to them was first drawn by Dr. D. D. Kosambi in 1962, who noticed that vegetation in the Dev Raies is different from that in the surrounding areas. They contain many tropical species like Holigarna grahami, Syzygium cumini, Ficus racemosa, Terminalia crenulata etc. They are not to be seen in the vegetation around Dev Rai. The vegetation, like that of Sholas in Nilgiris, stands in strong contrast with that of the surrounding areas made up of deciduous trees, scrub or a few bushes and grass. Dev Raies also contain Gnetum ula, Entada pursaetha, Salacia macrosperma, Hiptage madablota, epiphytic ferns like Leucostegis pulchra, Psilotum nudum, Lycopodium hamiltoni, orchid species of Dendrobium, Eria Oberonia. Obviously they are the left overs from the vegetation of past ages and therefore are considered as relict.

There are about 250 Dev Raies in Western Ghats, and a few elsewhere in different parts of India. Gadgil and Vartak (1975, 1976) have studied them. Since these Dev Raies have ancient vegetation different from that in the present deciduous forest around, the question of their age needs consideration.

Some plants belonging to Palaeocene of Deccan and many of Neocene and some of later period given by Sahni, Uttam Prakash, Mrs. Chitaley, Lakhanpal, Ramanujam, R. Dayal, Biradar, Mahabale and S. V. Rao. Satyanarayan, Ingale, Bonde and others occur here. From that it is seen that some plants found in the Deccan Intertrappean flora of Nagpur-Chhindwada area are there. The temperate species are few, but species like Pygium gardineri, Gmelina arborea, Leea macrophylla seem to have continued. They are now common in semi-evergreen and deciduous forests of Deccan. The genus Leea has 6 or 7 species in different habitats. Leea sambucina is found in dense evergreen forests in North Kanara but other species, Leea macrophylla and L. microphylla are found in dry semiarid regions of Deccan. Leea sambucina is not a woody species but the other two are woody species found in scrub or dry deciduous forests. Similar is the case of Elacoutia species. This clearly shows that the vegetation in the past as of today had pockets of semi-evergreen vegetation, and that larger areas had dry deciduous forests, and semi-evergreen pockets. However the vegetation in the past must have been much richer than it is today. For example, Tectona grandis, Adina cordifolia, Mitragyna parviflora common in many parts of Deccan are not as tall or rich as in Alapalli forests in Chandrapur district. They form a very rich formation there. The average height of trees there is above 80—90' and in some cases 141' high. On the other hand in the semi-arid region elsewhere on Desh, and even on top of Sahyadris at Mahabaleshwar getting 250" rain, they grow stunted, hardly 30-40'. They do not appear to belong to the same species. Probably the geomorphology, micro-climate sub-stratum, and ratio of dry to humid period

in a year appears to be the cause of it. The tropical species are seen on the middle slopes of Ghats where there is sufficient rainfall, sustained moisture and broad sunshine. Thus the tropical elements like *Hopea*, *Deptrocarpus*, *Holigarna*, *Hymenodictyon*, *Garcinia* species grow generally there in the middle of the Ghats above 2500-3000. These plants appear to be relict species of past vegetation.

It is well-known that present position of Deccan had not been the same towards the end of Cretaceous and early Eocene or Palaeocene period. Palaeomagnetically it has been ascertained that it was at 7° in Southern tropics, but due to subsequent geological changes in tectonics, it moved about 15° N. Therefore the plants that we find in Dev Raies today are due to such distant historical changes, possibly in Neocene or Miocene when many plants migrated, some towards Nilgiris and some towards Kateru, Pungide and Rajamundry, and some towards Cuddalore.

The flora of Dev Raies is therefore considered to be due to successive historical changes and not due only to climatic changes.

We have already seen earlier the different plants that are found in different Dev Raies in Kolhapur district and those that occur in Savarde Rai. The vegetation and past history of all Dev Raies is worthy of detailed investigation.

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D. SOME NEWER DISCIPLINES IN BOTANY

Botany today has become many-sided, and some important developments have come into existence as aid to taxonomy or economic botany. But not much work has been done and hence we shall consider them briefly.

18. AERO-BOTANY AND PALYNOLOGY: ITS APPLICATION TO PROBLEMS

This includes study of minute parts of plants such as pollen, spores, cuticles, bacterial and fungal spores floating in air. At about 300 above the ground they have been collected; beyond 500 to 1000 high up they are practically not there. The study of pollen grains and spores needs special methods to collect and to determine their intensity or numerical multitude. This is done with the help of Aero-palyrographs obtained on a clock-like rotating machine on which slides are fitted with a thin layer of vaseline to catch the spores and pollen floating in the air for 24 hours, and a record is kept. The importance of this lies not only in recognising botanically the plants to which they belong, but in the fact that some of them are capable of causing and spreading diseases. Some cause allergy, and therefore various aspects of this subject are being pursued vigorously by workers on air pollution.

The spores and pollen being single-celled organisms, very elaborate terminology has been evolved to describe them mainly by the efforts of the late Prof. Gunner Erdtmann of Sweden. He has decribed the morphology of spores and pollen and their relation to present taxonomy based on flowers and other parts of the plant. This is known as palyrology and its importance is growing mainly because it helps to distinguish such genera and species as could not be otherwise differentiated on the basis of gross taxonomy. It is, therefore, an important discipline among others to determine the systematic position of the genera, species and families. The spores and pollen, though are very small, they have their own morphological, physiological and chemical characteristics; for example, the pollen grains of various species of Compositeae and Acanthaceae. They are distinguished on the basis of pollen grain characters. Many fungal spores are distinguished by using Scanning Electron microscope.

But more than the mere descriptive palynology, its application to fossil spores and pollen is found in the coal bearing strata and ir coal itself. It is of immense use to detect the kind of coal and stratigraphic position to the coal in different horizons. If a particular spore is having a distinctive character and is distributed in a particular layer in the strata, it is very helpful to find further coal or oil. The oil bearing strate and coal strata have their own flora of pollen and spores. Many of them are very small and are distinguished as belonging to a particular group of plants or species. But this is very often not possible and therefore, they are merely described as small spores, microspores or miospores, if they are less than 30um, and megaspores if more than 30 um. This classification worked fairly well because in recognising spores of the oil and coal bearing strata, it is not so important to know what exactly were their genera, but which is the index spore and whether it is available in 60 or more percentage. This method of using palynology in coal and oil exploration on the basis of spores is used the world over, including India. For example, the spore Dandotiaspora is common spore of Tura formation in Assam and is considered to be Index of the strata which is likely to yield oil. Similarly, the fossil spores of many coal

bearing strata of Gondwanas have also been scanned and their occurrence right from the very base of the Gondwana formation to the top most layer have been studied by the Lucknow School of Paleobotanists at the Birbal Sahni Institute of Paleobotany, Lucknow, and by the members of the Geological Survey of India, ONGC (Oil and Natural Gas Commission), Dehra Dun.

The fossil spores are generally described as "Sporae dispersae". In Maharashtra the work on the coal and oil palynology is being done by the professional experts of the Oil and Natural Gas Commission and by workers on coal mines. The findings of the former are not open to all and the latter only to a few. It is only now that the palynology of the coal bearing seams at Umred, Savner, Singareni and other places are being studied, by Dr. Shripad Agashe at Bangalore, etc.

Fairly advanced work is done on the other hand by applying this discipline to the problems of honey by Dr. G. B. Deodikar, Dr. Thakar, Shah, Salvi and Dr. Suryanarayana, Dr. Phadke and other members of the Central Bee Research Institute, Pune. This branch is called Mellito-palynology. It was known for a long time that the honey contains spores and pollen of unknown plants and gives colour or taste to honey; but the systematic efforts were done by the above institution only as early as 1954. Dr. Deodikar, Shri Thakar and Dr. Chaubal have described the pollen grains of major honey plants at Mahabaleshwar and have described them morphologically. They have also been able to recognise the pollen grains found in different honeys at Mahabaleshwar. The kind of honey is now recognized on the basis of the pollen grains found in it. They were so recognised before only in certain kinds of honey such as Rose honey, Lotus honey of Kashmir or Eucalyptus pollen in the honey of some foreign lands like Australia. At Mahabaleshwar they have been able to recognise honey from different apiaries, in different seasons, depending upon the outburst of pollen in the spring and in October seasons. Thus they recognise now the Karvi honey collected by the bees from Karvi plants Carvia callosa, Strobilanthes species, Nilgirianthus sp., Randia en Gela Honey from R.dumetorum, Jambhul Honey from Syzygium cumini, etc.

Disease forecasting:

Like temperature, rainfall, humidity and other climatic data collected and announced day to day and week to week by the Meteorological Department, in certain countries, they also announce palynological data. This is because certain pollen grains are supposed to cause asthma. skin diseases and so on. In Maharashtra State not much work has been done on this, which is necessary. Of late, a very pernicious weed from South America called Parthenium hysterophorus has come to India during war time, along with food grains. It has spread fast and wide in Maharashtra and other parts of India. All the open spaces are completely covered by it within a few years. It does not allow even grass to grow with it. The result is that many cultivable and open lands have been overgrown by it. No method of eradicating it so far has been found either by the use of chemicals, weedicides or biological control. It is believed that pollen grains of wild Solanaceae, Casurina, even Eucalyptus are prone to cause irritation, cold and lung diseases. Some people are allergic to pollen grains of a particular species. This was tested in a number of people. They were found to harbour pollen grains in their breathing track.

Dr. Mrs. Chitaley of Nagpur had made certain experiments to know upto what altitude the pollen grains are found, and what are the species of them. She found that many fungal spores of Cladospora, etc. are in air at high altitude. Prof. S. B. Mujumdar found them over sugarcane fields in Maharashtra.

- Dr. S. T. Tilak has worked on the aero-flora of Aurangabad in which he found that the most prevalent spores at the end of rainy season and at the beginning of winter are the fungal spores of Cladospora, which are also found over the sugarcane fields in a number of places, besides yeast spores, and bacteria. It was also observed that the pollen of Parthenium hystero-phorus was present in air all the time of the year except in summer. This shows the pernicious character of this weed. It induces allergy in some, the symptoms of which are similar to those of some insect bites. In other places the pollen was of Argemone mexicana. Pollen of certain Solanaceae and Casuarina equisetifolia, grasses is reported to be injurious to eyes. In the lung track of several people who suffered from asthma had more than 10-12 species of pollen grains and spores in their breathing track. This clearly shows how important it is to know the pollen and spores floating in the air over a place, particularly cities and industrial towns.
- Dr. K. C. Mehta of Agra has found that rust disease of wheat in peninsular India is due to spread of uredospores of Wheat Rust on Barbery leaves growing in lower reaches of Himalayas, Terai, Nepal. From there they come to peninsular India and spread all over. There are no Barbery plants in the hills of South India; Barbery is the alternate host of wheat rust. There is a Rust Research Station at Mahabaleshwar where all known physiological races of Puccinia graminis-the Wheat Rust, are maintained and rust resistance of wheat species and strains is determined.

The microspores or pollen of Xanthium strumerium, Lantana camara Brassica nigra, Setaria intermedia, Moringa oleifera, Acacia nilotica Cassia siamea, Casuarina, equisetifolia, of some grasses like Cenerus and others are often found floating in the air over the industrial cities like Calcutta. Extracts of pollens of these plants were made in glycerinated buffered solutions and after standardisation were tested by Dr. P. M. Wagle and Dr. S. H. Godbole of the Maharashtra Association for the Cultivation of Science, Pune. They were tested for allergenecity on a group of 75 suspected allergic persons, and on patients actually suffering from asthma and Rhinitis. The results showed that 1/3 of these patients were susceptible to allergy by pollen. Similarly spore extracts of Helminthosporium, Aspergillus (A. fumigatus and A. niger), Trichothecium, Cladospora and Alternaria species were tested subcutaneously. The test showed allergic symptoms in many (Wagle, P. M. in Annual Report of the Maharashtra Association, for cultivation of sciences 1977-78: pp. This shows that quite a number of individuals are susceptible to pollen or spore allergy. This is a branch of palynology which is of vital importance to man. Therefore, testing on a large scale for allergy is necessary in other cities as is done at the Sardar Patel Chest Research Institute, New Delhi.

Agriculture:

Aero-biology is a young science based largely on incidence of spores in air causing diseases in plants, men and animals. The most important of these pathogens are those which are suspended in air over crop fields. These are mostly Basidiomycetes lig. smuts and rusts. Other groups are

also represented, but these cause the largest damage to food crops, and therefore, tracing their incidence, time of dispersal and attack of disease are of considerable importance in Disease Forecasting Service. In India such studies are very few. There is no regular system of disease forecasting along with meteorological data. Work on this branch was started mainly due to efforts of the late Dr. Shriramalu of Andhra University and in Maharashtra by Dr. Tilak of Marathwada University, Aurangabad.

It has been observed that the maximum concentration of the spores in air, particularly the fungal spores, is at the surface of the soil, from where they spread elsewhere. In crop fields the optimum time of growth of a crop is important, because the spores attack the crop during that period, the damage is considerable. The various factors governing the dispersal of spores have been enumerated by Gregory, Tilak, Shriramalu and other workers on plant pathology. It has been found that fungal spores spread in large concentrations not during night but during the relatively drier period of the day between 9 a.m. and 2 p.m. Sometimes there are two peaks of the concentration of the fungal spores in air during a day. Different months have different fungal spores in the Generally, in the pre-monsoon period their concentrations are large, and they get dispersed on a larger scale. But during rains, and when the dew falls, their concentrations become less as they are precipitated on the soil or get inflated. The incidence of smut spores in relatively dry month of August in Kharif season is more and again in the months of December and January in Rabi season. Rust spores, on the other hand, are found in large concentrations during the months of Rabi season. Their periodicity, incidence and concentrations depend upon various factors such as microclimate, density of growth of the crop, temperature and initial concentration of the disease spreading. It is well known that uredospores come all the way from Himalayan reaches, Terai and Nepal and spread with monsoons all over the country spreading rust disease. The situation in various places varies and also the agricultural practices. There is no one month that could be said to have standard conditions. They are seldom available, and variants of them is a general rule.

Vertical profiles of palynograms reveal certain other facts made out by Dr. T. Shriramalu and his associates Subba Reddy and V. Ramakrishnan. Sugarcane is a major cash crop of Maharashtra and Andhra Pradesh. A definite correlation of the different spores with season is noticeable. Rust and smuts are generally spread from June to September and in pre-monsoon period. The control measures, therefore, will largely d pend on the detailed knowledge of the season in a particular year, coupled with meteorological data. But this is seldom done. The result is that the disease becomes known only after it has spread on a large scale. Sometime back there was incidence of Phytopthora infestans the well known Potato Blight disease at Panchgani. This was made known only when one of the workers in the Pathology Department of the Maharashtra Association, Pune, Dr. A. V. Sathe (1974) wrote about it. Agriculture Department then started measures against it, but by that time major part of the crop was already damaged. Therefore, detailed and exact knowedge of the initial concentration of the pathogenic spores, their perioicity, the climate conditions, and knowledge of the local agricultural Practices are very essential for disease control.

As a matter of fact, the fungal and bacterial spores also cause diseases to plants from plants, to man and animals, A separate branch of this subject called Zoonosis has been developed. Shri Dev of Animal

Products Institute, Pune, has written a book in Marathi called "janawaranche Rog, Wa Tyanche Aarogya". It is interesting and helpful. It may be consulted.

19. LANDSCAPE GARDENING

Another branch in which very little progress has been made is the Landscape gardening. Floriculture is mainly concerned with ornamental plants. They are distributed by the various nurseries.

Landscape gardening, however, is only recently coming up as a subject along with Civil Engineering studies. In this branch the natural topography, trees in the surroundings and shrubs are so grown with cultivated ones as to merge together. The whole thing looks like a huge garden extended over a large area of landscape. Two best examples of Landscape Garden in the State are the Ganeshkhind Botanical Garden in the Poona University Campus where the landscape gardening was introduced by Sir Humphrey Repton in the year 1842, and a Forest Park and Botanical Garden at Hiwre started by Dr. Alexander Gibson in 1840. Another excellent example of the landscape garden in the country is the Government Botanical Garden at Ootacamund. Here the ornamental garden merges with the Natural Park, which in its turn merges with the forest in the background. The effect is that the whole hill looks as if it is a continuous planted garden. However, such attempts have not been made in Maharashtra State although the government have planned certain reserved areas for such developments.

The importance of landscape gardening lies in the improvement of the rural side and in planning of towns in urban areas. The landscape gardens afford a unique aesthetic pleasure to the citizens and hence most of the advanced countries have a large number of landscape gardens developed e. g. in Scotland, Holland, Southern France, Switzerland, Italy, Uzbeckistan, etc. where advantage is taken of the natural scenery, and the cultivated plants are grown according to a particular plan. They are also important for Plant Introduction.

In the whole world there are about 250 botanical gardens of different kinds. In our State there are six large parks. One is the famous Victoria Garden now called Jijamata Udyan at Bombay; the Hanging Garden on the Malabar Hill, Bombay; Empress Garden of Agrihorticultural Society at Pune; the erstwhile Ganeshkhind Botanical Garden at Ganeshkhind, Pune; Maharaj Baug at Nagpur and the old Mughal Garden at Khuldabad near Aurangabad.

20. ETHNOBOTANY

Plants enter into various activities of man and also afford him the food. In Maharashtra a lot of poor people live in hills and in the tracks which are not fertile. Their food requirements are not met ordinarily from the minor cereals and other poor food grain plants they grow. Maharashtra had been deficient in food production. It is estimated that about 2.5 million tonnes of food grains are required every month for Maharashtra from outside, besides the quantity that it itself produces. This is a rough estimate used by the government to import food from outside Maharashtra. Tribals like Bhils, Kolis, Katkaris and Dhodias have to supplement their food by using articles other than grains. Due to poverty they use many plants or their parts as supplement to their food. Most of these are tubers and underground parts which contain a

large amount of stored starch as food material, besides leaves of some wild plants. Such plants have been enlisted by Jain, Vartak and Datar (1975). They have studied the tuber crops and other materials used as food by poor people living in hills. A list of some of them is given below:—

Equally important is the problem of feed and fodder for cattle, because the grasslands dry up, and the forest trees shed their leaves in winter. There is no green fodder for the cattle. The cattle and sheep-keeping nomadic people migrate from drier areas to hills and to upland areas in search of some green grass, new foliage and edible plants. They feed on anything that is available.

A list of plants used as food by Adivasis (After Rekha Datar and V. D. Vartak, 1975)

(A) Tubers of the following are eaten after boiling:-

Amorphophallus campanulatus Beume
Arisaema murrayi Hook
Dioscorea alata Linn
Dioscorea oppositifolia Linn
D. bulbifera L.
Vigna capensis Walp.
Ensete superba Cheesemann (= Musa superba)

(B) Leaves, flowers and seeds of several fleshy plants are eaten.

- (C) Fruits of several wild plants such as Capparis zeylanica, Grewia abutifolia, Zizyphus species, Phoenix sylvestris and Ph. robusta, Syzygium cumini, Gmelina arborea, Ficus species, Emblica officinalis, Artocarpus heterophyllus, Carissa congesta, Cordia spp., Dillenia pentagyna, Diospyros melanoxylon, Moringa oleifera.
 - (D) Leaves of the following are used:-

Murraya koenigii
Portulaca oleracea
Smilax zeylanica
Cassia tora
Leea macrophylla
Aroid-leaves and tubers eaten
Oxalis corniculata
Cordia dichotoma
Bambusa bambos
Moringa oleifera
Nymphaea pubescens
Phaseoelus radiatus

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21. PARKS AND GARDENS

The utility of plants to man is not only for food, but also for aesthetic pleasure. For this purpose gardens, parks, reserved areas in forests are kept as Reservation Plots. Such national parks or gardens however are very limited in number and they all are not always open to public, because the effect of man has been found to be very destructive to such parks. People use them indiscriminately. Despite this, there is a National Park at Borivli; the well-known Tadoba Park in Chandrapur District; the famous Tiger Sanctuary in Melghat beyond Paratwada (Amravati district); Pratapsinh Park at Mahabaleshwar; Empress and Ganeshkhind Botanical Gardens, Pune, Maharaj Baug at Nagpur; Jijamata Udyan at Bombay; Hanging Garden at Bombay; and Karnala Bird Sanctuary are some of the famous parks in Maharashtra.

Floriculture:

Strangely enough more than half the flowers in towns like Pune or Bombay come from Bangalore, Dahanu, Devlali (Nasik) and other places, because there are very few regular large flower gardens. Only a few people grow them on a commercial scale, e.g. nurseries at Devlali near Nasik, Panchgani, Narayangaon, Sarola near Ahmednagar and a few other places. The tuberous flowering plants such as Gladioli, Polyanthes are widely cultivated near the large towns where they have a market. Roses are cultivated at Dahanu, Vasai, etc. Many of these are imported varieties. Due to the efforts of the Rose Societies and Agro-horticultural Society they are getting popular. In parts of Scotland, Southern France and in West Germany there are several beautiful gardens of roses and medicinal plants. At Chandigarh there is a 1000 acre Rose Garden. Cultivation of medicinal plants is not yet an industry, though they are required and used in many medicinal preparations according to Ayurvedic standards and prescriptions. Therefore Health Ministry of Govt. of India has started collecting and growing medicinal plants in gardens. One such garden in Maharashtra State is at Kothrud near Pune, known as Jawaharlal Nehru Ayurvedic Vanaspati Udyan. Here mostly the herbaceous and shrubby medicinal plants have been cultivated and others are being attempted; but the growth of drug yielding trees is slow, as they take time to grow to full stature to be a source of drug. The climate of Maharashtra and the varied structure of terrain from river bank, plains to high hills, cold and dry weather are extremely congenial for the growth of medicinal plants. But it is not yet thought to be industrially feasible by the people for want of knowledge and experience. The result is a number of pharmacies depend upon the local collectors who know where various medicinal plants grow wild. They collect them and sell to the pharmacies such as Zandu Pharmacy at Bombay, Dhutpapeshwar at Panvel, Pharmacy of Ayurved Seva Sangh at Nasik, Sandu Bros. Pharmacy at Chembur, APHALI at Ahmednagar, etc. Medicinal plants have been described by Agharkar. It will be seen that more than 100 medicinal plants which are useful for several medicinal preparations are available in Maharashtra. But their systematic cultivation and exploitation is yet not practised. Many Ayurvedic physicians use substitutes for particular drugs, when the original drug yielding plant is not available. This was realised as early as 1840 by Dr. Gibson and he had started collecting and growing,

Gazetteer of Bombay State, Botany (Revised Edition, 1953), Part-I Medicinal Plants.

medicinal trees and plants in his famous garden at Hiwre (District Pune). The hills and the Ghat regions particularly are very suitable for the growth of medicinal plants and trees. Konkan (Sawantwadi) and Chandrapur areas are known for many medicinal plants. Cultivation of roses on industrial scales, as is done around Lucknow, Gaziabad, Kanoja, Bangalore is well worth expanding as a rural industry as CIBA are doing in Goa for some medicinal plants.

22. BEE BOTANY AND OTHER BRANCHES OF TAXONOMY

A new development of Botany in Maharashtra is Bee Botany. It is mainly due to the work of Dr. G. B. Deodikar and his associates. Bees are good pollinaters and by putting hive lines in the crop fields or horticultural gardens, the yield is enhanced considerably, sometimes even 100 per cent. A large number of flowers do not form seeds because a particular pollinater is not present there. Yucca gloriosa plant and Yucca moth in Australia are classical examples of this. Application of this discipline in Agriculture and Horticulture is obvious.

There are three species of bees in Maharashtra. Rearing and keeping bees is a cottage industry in hilly parts. Besides these, there are two other branches of Botany viz., Numerical Taxonomy and Chemostaxonomy. But there is no work on them in Maharashtra except two papers by Chandras (1968), and Chandras and Kelkar, Forest Ecology, Statistics. Plant introduction is also a neglected discipline in this State.

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E. FOSSIL PLANTS OF MAHARASHTRA AND FOSSIL FLORAS

23. Fossils and their kinds

Fossils are the remains of ancient plants and animals that lived in the past ages. They are preserved in the strata of rocks, but only in sedimentary rocks formed by continuous process of sedimentation. This requires aquatic and other suitable conditions for their formation, Therefore, fossils are not found everywhere. They are sometimes washed away from their original place and are re-deposited or scatterd elsewhere. Such conditions occur at the bottom of lakes, shallow seas, estuaries, river banks and similar places. It is possible with their help to determine heir age, and of the strata in which they are found.

In Maharashtra, the sedimentary rock system is known from two series, the Gondwanas and the Deccan Intertrappean Series. Besides these two, sometimes we get impressions on shales on the banks of rivers such as Pravara, Adhala, Godavari, Pranahita and Wardha. They be ong to different periods. The Gondwana system in Maharashtra is malinly exposed in the Wardha-Pranahita-Godavari valley and around Kamthi, Umred etc. The second system, the Deccan Intertrappean Series, occurs here and there over an area of 20,0000 sq. miles of Trap rocks spread from Bombay to the vicinity of Rajahmundry, from Satpuda mountains to Vikarabad, from Indore Sitapuri to Damoh, Goona, Sagar in Madhya Pradesh. The Gondwana rocks were formed under very special conditions in the valleys of Peninsular India where there were thick forests. They were sunk or covered later with ice sheets. Due to them a lot of coal has been formed in Bastar in Madhya Pradesh, in the valleys of Godavari, Pranahita, Wardha and Krishna rivers, in Talhir near Cuttack in Mahanadi and in Damodar Valley.

The Gondwana system is supposed to consist of Upper, Middle and Lower divisions. It began from the Upper Palaeozoic era and continued throughout the Mesozoic upto Lower or Middle Cretaceous period in Peninsular India. These deposits are rich in coal and are exposed at the fringe of Deccan Trap country. The Deccan Intertrappean beds also occur at the fringe of Deccan Trap Country. The Gondwana deposits are present also in extra peninsular India, but they are not fresh water deposits. Most of the coal deposits in Maharashtra, Madhya Pradesh and Orissa are fresh water deposits of the Gondwana period and are of great economic importance. They contain some of the best coal-bearing strata of India.

24. FOSSILIFEROUS STRATA IN MAHARASHTRA: THEIR AGE AS PER INTERNATIONAL GEOLOGICAL TIME SCALE

The oldest age determination carried out for Indian rocks on the basis of radiometric measurements is about 3500 million years.

The entire time-span of the earth's history has been divided into four eras, viz., Precambrian, Palaeozoic, Mesozoic and Cenozoic. During Precambrian era, the rocks formed in India are identified as Dharwar, Aravalli, Cuddappah, Delhi and Vindhyan Supergroups. They range in age from about 3500 m.y. to 600 m.y'. the beginning of the Palaeozoic The Palaeozoic era extends from 600 m.y. to 270 m.y. The major rock formations belonging to this era are coal-bearing Lower Gondwanas. In Maharashtra these rocks occur in Vidarbha. The Mesozoic era begins with Triassic period (225 m. y.) and ends with Cretaceous period (70 m. y.). The great volcanic activity commenced sometime in the Upper Cretaceous. A huge pile of basic rocks was formed due to successive eruptions of lava. The greater part of Maharashtra is occupied by these rocks. This activity continued during the early part of the Cenozoic era. The Cenozoic era started with Palaeocene epoch and continues to date. This era is divided into two divisions, the Tertiary and the Quaternary. The climatic fluctuations were experienced during Mio-Pliocene and also continued into Pleistocene. It shows alternation of glacial and interglacial climates. During Quaternary newer alluvium, delta deposits and blown sands etc. were formed. Similarly land has arisen which can be noticed from river terraces and raised beaches.

^{1.} M. Y.=million years.

GEOLOGICAL TIME SCALE

Era	Period	Systems Epochs or series	Fossiliferous Localities	Geochrono- logic age in million years	Total duration of the System (million years)	Remarks ()
Ξ	(2)	(3)	(4)	(5)	(9)	(7)
		Recent	Travertine beds of Kotul in Ahmednagar district.	0.01	0.01	
	Quaternary-	Sub-Recent	River valley leaf beds on Aluvium at Sangamner, Ahmednagar district.	4	:	
		Pleistocene	Leaf beds at Khandarmal	1.5	1	
		Pliocene	यम		7	
Cenozoie		Miocene	Bombay-Worli and Bombay High, Bombay	, 26	17	Most of the oil in West coast at Ankaleshwar and Bombav High
	Tertiary	Oligocene	में	38	13	belongs to Miocene period.
		Holocene	Nagpur, Nawargaon and nearby localities in M.P. (Chhindwara, Sausar, Sagar).	54 65	27 10	Abundance of Angiosperms, dwindling of Gymnosperms.
		Cretaceous	Upper	140	75	Angiosperm including palms arose.
Mesozoic:		Jurassic	Lower	200	9	
(180m. y.)	Gondwans	Triassic	:	240	4	Most of the Coul resources are found in Gondwang period.
		.		÷		Age of Gymnosperms.

GEOLOGICAL TIME SCALE-contd.

(7)			
(9)	50 80 35 108 108	1,100	:
(5)	290 350 410 505 635	2,500	3,600
(†)	Permian Chandrapur, Nagpur		•
(3)	Permian Chande Cabóniferous Upper Lower Devo.an Silurian Ordovician Cambrian	Pre-cambrian	Archeans
(2)	poirc	:	:
€	Palacozoic (370 m.y.)	Proterozoic	Azoic

25. GONDWANAS AND THEIR FLORA

The Gondwanas are divided into two divisions and according to others three divisions as mentioned above. Gondwana basin contains only a part in Maharashtra. Wardha, Pranahita and Godavari valley system forms a discontinuous chain of Gondwana rock exposures from Chandrapur to Rajahmundry. They also occur in small patches in Kaveri basin in Tamil Nadu.

We are mainly concerned with this system that occurs in Maharashtra. The distribution of Gondwanas in Deccan Trap Country is given elsewhere. Their several isolated localities occur in Deccan by which we mean the region which lies to the south of Narmada and to the north of Kaveri. The most important Gondwana areas in Maharashtra are those that occur in the Wardha-Pranahita-Godawari basin. They have flora comparable to that of Kota-Maleri or Rajmahals or Cutch. According to Wadia (1966), Lele (1973) and Surange (1964) they belong to Middle Gondwana (Triassic).

It is generally believed that in the early Gondwana period Dicroidium flora was abundant. Later it was succeeded by the Ptilophyllum flora in Upper Gondwanas. In between the Neo-calamite, Schizoneura, Glossopteris, Dicroidium, Noeggerathiopsis, Gangamopteris occur in Transitional Beds representing the Middle Gondwana flora. Each of these floras have their own peculiarities and constituents.

The Gondwana system contains the following seven stages:-

Lower Gondwanas:

Talchir stage in Maharashtra is found only on the banks of Wainganga river above its confluence with Wardha river 16 kilometres W-SW of Chandrapur. It is exposed fully in Madhya Pradesh in South Rewa basin in Johilla coal field. Fossil plants Gangamopteris, Noeggerathiopsis, seeds of Cardaiocarpus and Samaropsis are found in them.

Karharbari stage is not represented in Maharashtra but in Rewa in Madhya Pradesh. Its characteristic elements are Buriadia and Gondwanidium.

Barakar stage is well exposed in Bihar and has good coal. In Maharashtra it is exposed in small disconnected out crops forming a chain from Chandrapur down to South, but they are not much known. They need to be studied.

Raniganj stage is exposed in different fascias in Maharashtra, principally in the coal fields of Kamathi, Koradi, Savner around Nagpur in ferruginous masses of sandstone. Kamathi stage is considered as equivalent to Raniganj of Upper Gondwanas. It is very well developed around Kamathi about 19.2 km. from Nagpur. In sandstones and argillaceous shales of Kamathi, fossil plants Phyllotheca, Glossopteris, Gangamopteris hughesii, Vertebraria, Taeniopteris, Noeggerathiopsis, Neocalamites are found.

Panchet or the last stage of the Lower Gondwanas occurs in Satpuda basin and at Mangli in Godavari valley. It contains Glossopteris communis, Vertebraria indica and Dicroidium sp. It is now believed to belong to the middle Gondwanas.

Kot-Maleri stage of Middle Gondwanas is developed in Godavari valley in the vicinity of Sironcha. Glossopteris, Schizoneura, Neocalamites, Cladophlebis, Araucarites, Elatocladus are found. They represent typical Dicroidium flora. It has logs of gymnosperms Cupressiono-xylon and Dadoxylon.

Upper Gondwanas:

Rajmahal stage is practically absent in Maharashtra. It contains *Philophyllum, Taeniopteris, Araucarites, Williamsonia, Gleichenites, Ginkgoites* and others, constituting of *Glossopteris* flora. On the whole very little Gondwana flora occurs in Maharashtra. Only important sector of it occurs on the banks of Wainganga before its confluence with Godavari. In the Godavari valley *Ptilophyllum* flora definitely seems to have been succeeded by *Dicroidium* flora. Upper Gondwana flora is poorly represented down Sironeha, after the confluence of Pranahita with Godavari, upto Raghudevpuram (East Godavari district) and Rajahmundry. They offer an excellent field for research. Their resemblance with that in other parts in the country is yet to be decided. It is characterised by marine sequences and by the prevalence of *Ptilophyllum, Cycadophytes, Bennettitales, Williamsonia* and ferns like *Onichiopsis* or *Osmundites*.

By the time ice sheets receded the sea came up in the Wardha-Godavari valley. It again receded at a number of places and disturbed the glacial sediments. A special significance is attached to later Gondwana system, because of the Kamathi stage, near Nagpur. The Rev. Father Hislop first observed the Glossopteris leaf impression on the shales on the banks of river Kanhan here. When they were formed, the climate must have been very dry and desert-like. During the entire Triassic period (equated with Middle Gondwanas) the development of flora was discontinuous and occurs at distant places. Dinosaurs were rambling in Godavari valley from Paithan in Maharashtra to Maleri in Andhra Pradesh (Mahabale 1964). During this period the sea receded for a short time and came up again in Upper Gondwana period.

The middle Gondwana flora in Wardha-Godavari Valley has a large number of tree trunks of gymnosperms. Some of them are 2-3' in diameter and are found at Aghari, Agarjhari in Chandrapur. Dadoxylon, Plamoxylon, Kamthioxylon, Cupresinoxylon, Zenoxylon, Megaporoxylon are found. Species of Glossopteris gigas occurs in large numbers. Most of them are anomalous gymnosperms. At Bazargaon and Satnauri near Nagpur, a Scutum type of Glossopteris fructification is found. Schizoneura, Neocalamites are also found in sandstone quarries there and occasionally Vertebraria. Thus typical Gondwana plants occur at various localities around Nagpur, Kamathi, Wardha, Warora, Aghari and Chandrapur. They suggest that although the Kamathi formation is often equated with Raniganj stage (Upper Gondwanas), it appears probably a little earlier than the Raimahal or Jabalpur stage of the Upper Gondwanas. The phytogeography and ecology of this fossil flora in Maharashtra is not worked out. What is its relation to similar flora elsewhere is yet to be decided.

By the time Gondwana flora started dwindling the Deccan Traps began pouring out lava at the end of the Uppermost Cretaceous. The process gathered great momentum in Palaeocene and continued pouring out hot lava at various places throughout Maharashtra in Eocene period. The lava flows were poured out intermittently on varied surface. There are many important places for the collection of Gondwana and Tertiary fossil plants. Literature on them is very vast as they are the earliest fossil floras known from India since the days of Feistmantel (1876-1882). Dr. Sheila Chandra and K. R. Surange's (1979) recently published extensive work on *Glossopteris Flora* of India be consulted with profit.

26. TERTIARY FLORA OF MAHARASHTRA: THE DECCAN INTERTRAPPEAN SERIES

After the Glossopteris flora, the second important flora in Maharrashtra is the Tertiary Flora of the Deccan Intertrappean Series related to Miocene or Neocene flora of Cuddore series in Tamil Nadu and to others elsewhere. The plants are preserved in the sedimentary rocks formed during the periods intervening between two velcanic outburst at a number of places in the Deccan Trap Country. The lava in the Deccan is supposed to have been poured out from long fissures which also got closed up later. They are seen now as many broad and long dikes and sills from where thin lava was supposed to have been poured out. It cooled and got consolidated. However, there are no cones or craters, usually found in the case of volcanic activity elsewhere. It is more like the type in Abyssinia, or like that in Idaho in America.

The rocks are amygdoidal and formed dark hard lava sheets, some grey and brittle. Sometimes the intervening period between two lava flows was long enough and allowed soil to be formed. On it the plants developed, and some new ones came up. They got embedded in the sedimentary deposits between two trap-layers known as Intertrappean beds. Admirably well preserved plants are found in them in cherts. It is known that silica is not soluble in water but Silicon trioxide in bot water is soluble to some extent. The flows were quite extensive, some times extending upto a furlong horizontally, but only a few feet in vertical height or thickness due to fluidity of the lava. The lava flows 3-12 poured outline parallel one above the other, often separated by thin layers of ash and look distinct and discontinuous. When the conditions became a little favourable, then the mud accumulated in intervening cavities during quiet period and allowed the plants to grow on them. only to be killed and preserved by the process of silicification. Even the most delicate plants like Azolla of flowers of Sahnianthus, Sahnipushpum, Veeracarpon, fungal hyphae and spores are preserved in the rotting tissues of wood fallen in lake waters; or else they got charred. This gave rise to petrified plants in cherts in the Deccan Intertrappean Series. They are, however, not found in the Upper traps near Bombay but generally in the lower and middle traps at Nagpur-Chhindwada area and in Malwa.

Intertrappean beds of Eocene period occur at Takli, Navargaon, Bori, Bharatwada, Mahurzari and Kondhali, all near Nagpur. Other places are Sausar, Chhindwada, Mohgaon-Kalan, Mandla, Chari, Samnapur, Parapani in Madhya Pradesh adjacent to Nagpur. They are exposed above the marine Cretaceous Bagh beds at Deola Chirakhan, Sitapuri in Madhya Pradesh. There are no fossils, however, in the highest hills of Sahyadris in Western India like Khandala except at Worli or Dongri in Bombay. Throughout the Eocene Period the effusion of lava was very severe and intensive. It ended in Cretaceous in the Godavari Valley in Andhra Pradesh. The next outburst of lava was in Miocene Oligocene period. This was mostly in Andhra Pradesh at Kataru, Pangide, Rajahmundry; and in Tamil Nadu in the Cuddalore series near Pondicherry. Their fossils are similar to plants today that occur in Maharashtra. Their preservation is not as good as it is in Chhindwada-Nagpur

area. They form the Cuddalore series and resemble with the modern species. Their fossils are intercalated with marine formations. Their structure is poorly preserved. In Tamil Nadu and at Neyveli, about 74 km. from Madras, huge lignitic deposits of the same age occur on a large scale, about 400 sq. km in extent. They provide fuel for the thermal electricity plant supplying energy to Madras. In Maharshtra no large scale lignitic deposits are known. It is known only in a well in the Theba Palace estate at Ratnagiri, Pavas and at a few other places.

There are well-known Miopliocene beds at places in Assam (Mizoram), called Tippam and Barails. They are also exposed in Himachal Pradesh at Jwalamukhi. But there is no comparison between the Early Eocene plants of the Deccan Intertrappeans with those in the strata at those places. The volcanic activity was also there at Anjar in Kutch and Saurashtra around Junagadh. They are, however, lithologically different, being some acid and some alkaline traps. We shall, therefore, mainly consider the Tertiary Flora of Maharashtra which belongs to the Early Eocene period, and make their brief comparison with those of the other areas.

Glossopteris flora of Mesozoic Gondwanas was followed by the Tertiary Deccan Intertrappeans and Quaternary Sub-recent Floras. Many of the Early Eocene Species are not there, but those in the Mio-pliocene Flora of Cuddalore Series are to be found in our present Peninsular Flora. Due to climatic fluctuations only a few have survived and that is why we get mixed species of different periods in our flora.

TABLE IX-E-26,1

Plant remains from the Deccan Intertrappean Series (Early Eocene) after
Uttam Prakash, 1972

Family	Fossil species	Modern comparable form	Locality
(1)	(2) सद्यमेव	वयते (3)	(4)
Gymnospermae Coniferales			
Abitineae	1 Industrobus bifidolepis Sahni	••	Tak li
	2 Takliostrobus alatus Sahni	••	Tak li
	3 Pityostrobus crassitesta Sahni	••	Tak li
Araucariaccae	4 Mohogostrobus Sahani Prakash	Araucaria	Mohgaon-Kalan
	5 Dodoxylon deccani Shukla	••	Chhindwada district.
	6 D. resinosum Shukla		Do.
	7 D. eocenum Chitaley		Chhindwada
	7a. D. shuklai Singhani	••	Chhindwada
Angiospermae Monogotyledons			
Musaceae	8 <i>Musa cardiosperma</i> Jain	Musa spp	Mongaon-Kalan
	9 Musocaulon indicum Ja n	Musa or Enséte	Do.
Smilacea	10 Smilacités mohgaoen- sis Nambudiri	Smilax asp ra .	. Mohgaon-Kalan

TABLE IX-E-26.1-contd.

Family		Fossil species	Modern comparable form	Locality
(1)		(2)	(3)	(4)
Zingiberaceae	٠.	11 Amomocarpum sulcatum Sahni	Ellettaria	Unknown
		12 A. affine Sahni	Ellettaria cardamonum	Unknown
Cyclanthaceae	••	13 Cyclanthodendron sahnii (Rode) Sahni	Cyclanthus carludovica	Mohgaon-Kalan
		14 Floral axis of Cyclanthaceae	••	Do.
Sparganiaceae	••	15 Sparganium Sp. Mahabale	Sparganium	Do.
Araceae	• •	16 Viracarpon héxaspér- mum Sahni	••	Mohgaon-Kalan and Takli.
		17 l'. elongatum Sahni Syr. Shuklanthus superbum Verma	1	Takli, Mohgaon- Kalan
		18 V. tenue Sahni	EAR.	Unknown
		19 Sahanipushpam shuklai Verma		Mohgaon-Kalan and Mahurzari
Gramineac	••	20 Wood of Bamboo		Worli, Malabar hills, Bombay and Mohgaon- Kalan.
Cyperaceae	••	21 Stem and Flower of Scripus	Scripus	Worli and Mala- bar hills,
		22 Cyperaceoxylon intertrappeum Chitaley and Patel	नयने	Bombay Mohgaon-Kalan
Palmae	••	23 Palmoxylon banfordi Schenk	••	Near Zhansi on Narmada
		24 P. libigianum Schenk	••	Sitabardi
		25 P. edwardsi Sahni	• •	Near Jabalpur
		26 P. sagari Sahni	••	Saugar
		27 P. kamalam Rode 28 P. hislopi Rode	••	Mohgaon-Kalan
		29 P. sclerodermum Sahn	·	Mohgaon-Kalan Seoni and Nawar gaon
		30 P. (Cocos) sundaram Sahni	••	Saugar
		31 P. sundaram Sahni ya vidarbhai Rao and Menon	г.	Mohgaon-Kalan
		32 P. surangei Lakhanpal	••	Kerala
		33 Palmoxylon sp. cf.	Phoénix rupicola and Phoénix robusta Mahabale	Mohgaon-Kalan
		34 <i>P. chhindwararence</i> Prakash	* *	Mohgaon-Kalan
		35 P. dakshaninence Prakash	••	Mohgaon-Kalan

TABLE IX-E-26.1-con.d.

Family	Fossil species	Modern comparable form	Locality
(1)	(2)	(3)	(4)
Pa mae-Cont.	36 P. eocenum Prakash		Mahurzari
	37 P. narayanai Rao and Menon	• •	Mohgaon-Kalar
	38 P. mahabatéi Rao and Menon	••	Do.
	39 P. parthsarathyi Rao and Menon		Do.
	40 P. maheshwarii Rao and Menon	••	Do.
	41 P. trabeculosum Sahni		Saugar (Sagar)
	42 P. fibrosum Menon	• •	Mohgaon-Kaiar
	43 P. deccanese Sahni	••	Maragour
	44 P. krishna Sahni	••	Sitabaldi
	45 P. scotti Menon	• •	Mohgaon-Kalar
	Dayal and Monon		Mongaon Tealur
	46 P. pyriforme Sahni	8	Sindhi Vihira
	47 P. intratrappeum Sahni	傷息	
	48 P. krauselii Rao and	10 10 10 10 10 10 10 10 10 10 10 10 10 1	
	Menon	\$300	Mo gaon-Kala
	49 P. ravi Menon	PR49	Do.
	50 P. su perabum Trivedi and Verma	41	Kerla
	51 P. cordatium Trivedi and Surange	11/2	Mohgaon-Kalai
	52 P. mohgaoensis Trivedi and Surange		Do.
	53 Palmocaulon mohagao- ense Leshp nde	जगने जगने	Do.
	54 P. ravi Menon	시에기	Do.
	55 P. mahabalei Menon	••	Do.
	56 Rhizopalmoxylun Nipa		Do.
	fruticans indicum Sahni	••	Do.
•	57 Palmostrobus sp. Mahabale	••	Do.
	58 Palmophyllum dakshi- nense Achutan	••	Do.
	59 Palmocarpon moligao- ense Prakash	••	Do.
	60 P. insigne Mahabale	••	Do.
	61 P. indicum Prakash	••	Do.
	62 P. sulcatum Prakash		Do.
	63 P. compressum (Rode) Sahni	••	Do.
	64 P (Iriarires) taklensis (?)	••	Takli
	65 <i>Palmocarpon</i> sp. Sahni		
	66 P. bracteanum		
:	67 Nipa hindi (Rode) Sahni	Nipa fruticans	
	68 Nipadites sp. Bowerbank		

TABLE IX-E-26.1--contd.

Family	Fossil species	Modern comparable form	Locality
(1)	(2)	(3)	(4)
Palmae-Contd	. 69 Nipa sp 70 Tricoccitės trigonum Rode	Nipa	Mohgaon-Kalan Do.
	71 Fruiting axis of Tricocates trigonum Rode		Do.
(Dicotyledons) Flacourtiaceae	72 Flacourtiates intertrappeum Nambudiri		Do.
Malvaceae	73 Hibiscoxylon intertrappeum Trivedi and Ambawar	<i>Hibiscus</i>	Mahurzari
Tiliaceae	74 Gréwioxylon mahurzariénse Prakash and Dayal	Gréwia laevigata	Do.
	75 G. indicum Prakash and Dayal	G, tiliaëfolia	Do.
	76 G. intertrappeum Shallom	<i>Gréwia</i> probably <i>G. lacvigata</i>	Do.
Elacocarpaceae	77 Elaeocarpoxylon antiquum Prakash and Dayal	Elaeocarpus ferrungineus	Do.
Simarubaceae , ,	78 Ailanthoxylon Prakash	Ai!anthus malabarica	Mohgaon-Kalan, Mahurzari and near Rewa.
	79 A. ghierense (Seksena) Prakash Verma and Dayal	Alianthus grandis	Ghiar Rewa
	80 Simarouboxylon indicum Shallom	Simarouba Spp.	Mohgaon-Kalan
Burseraceae	81 Boswellioxylon indi- cum Dayal	Boswellia serrata	Keria
	82 Wood of Burseraceae		Mahurzari
Sapindaceae	83 Sapindoxylon schleicheroides Dayal	Schleichra trijuga	Keria
	84 S. chhindwarensis Chitaley and Shallo	· ••	Mohgaon-Kalan
Ampelidaceae	85 Léeoxylon multisé- riatum Prakash and Dayal	Leea Spp	Mahurzari
Anacardiaceae	86 Anacardoxylon semecarpoides Prakash and Dayal	Semecarpus Spp.	Do.
Leguminosae	87 Aéschynomena tertiara Prakash	Aeschynomène sp.	Do.
	88 Fruit of Hedysareae		Takli
	89 Fruit of Cassia .		Do.
	90 Fruit of Foboidea Boweebank	••	Do.
	91 Fruit of Xulino sprinites	••	Do.
	92 Leaflets of Acacia.	• ••	Worli and Malaba hills

TABLE IX-E-26, 1-contd.

Family		Fossil species	Modern comparable form	Locality
(1)		(2)	(3)	(4)
Combretaceae	93	Terminalioxylon tomentosum Mahabale and Deshpande	Términalla tomentosa	Ghala
Myrtaceae	94	Dryoxylon mohgaoense Rode	••	Mohgaon-Kalan
Lecythidaceae	95	Barringtonixylon	Barringtonia	Mahurzari
	96	B. eoptrocarpum Prakash and Dayal	<i>acutangulata</i> Barringtonia <i>acutangulata</i>	Do.
Lythraceae	97	Leaf of Lagerstoremia	Lagérstoremia indica	Mohgaon-Kalan and Bharat - wada, Dedukur near Rajah - mundry
Sonneratiaceae	98	8 Sonnératixylon décurénse Krrishna Rao and Ramanujam	Sonnératia Sp.	immary
		Wood of Sonneratia Wood of Sonneratia and Duabanga	Sonneratia Sp. Duabanga spp. and Sonneratia Spp.	Mohgaon-Kalan
	101	Sahnianthus Parijai	Sonnératia acida	Mohgaon-Kalan
	102	Enigmocarpon Paarijai	Sonneratia apėtala	and Bharatwada
Euphor biaceae	103	Bridelioxylon krauselli Prakash	Bridelia spp.	Keria'
	104	Mallotoxylon keriense Lakhanpal and Dayal	Mallotus philippinensis	Do.
	105	Paraphyllanthoxylon sahnii Prakash	Phyllanthoideae group	Mahurzari
	106	Paraphyllanthoxylon keriensé Dayal	Briscofia	Keria
	107	Euphorbioxylon sagarense Mahabale and Deshpande	Bridelia sp	Saugar
Datiscaceae		Tetrameleoxylon prenudiflora Lakanpal and Verma	Tetrameles nudiflora	Mohgaon-Kalan
Guttiferae	109	Wood of Guttiferae		Mahurzari
Rutaceae	110	Wood of Rutaceae	••	Near Nagpur
Incertaesedis	111	Aérorhizos harrisi Chitaley	••	Mohgaon-Kalan
		Dicotylirhizos sahnii Rao	<i>z</i> ·	Do.
	113.	Phyllites mohgaoénsis		Do.
	114	Rode Dicotylophyllum mohgaoensis	• •	Do.
	115	Nambudiri D. intertrappeum	••	Do.
	116	Nambudiri Indocarpa intertra-	••	Do.
	117	ppeum Nambudiri Carpolithus striathus		Do,

Distribution of the modern compa able species of fossil taxa from the Cuddalore series (Age-Mid-Miocene), after Prakash 1973, Geophytology 2

(2): 179. with living once,

TABLE IX-E-26.2

F	ast Fossil species	Modern Comparable species	Present Distribution
1.	Mesuoxylon arcoténsé	Mesua ferrea*	Evergreen forests of Western Duras, Assam, Mizoram, Nagaland, Arunachal, Chittagong, Upper Burma, Tenassarium, Andaman Islands, Western Ghats of North Kanara Southwards to Tinnevelly.
2.	Calophylloxylon indicum	Calophyllum wightianum	Evergreen forests of Western Ghats, North Kanara to Kerala.
3.	C. cuddalorense	Calophyllum tomentosum and C. insphyllum*	Evergreen forests of Western Ghats from North Kanara to Kerala, West coast, Orissa, Andamans, Burma, found along coasts above high water mark and in mangroves.
4.	Glutonylon	Gluta travancorica and G. melanorrhoea	Evergreen forests of South Kerala South-east Asia.
5.	Mangiféroxylon scleroticum	Mangifera altissima	Malaya in evergreen forests.
6.	Ebenoxylon arcotenses	Diospyros assimilis	Evergreen forests of north Tamil Nadu, Western Ghats, South Kanara to Kerala, from 1200- 4000 altitude.
7.	Cynometroxylon dakshinense	Cynométra travancorica	Evergreen forests of South Kerala and near Tinnevelly.
8.	Tamarindoxylon antiquam	Tamarindus indica*	Evergreen tree diffused out India and in generally.
9.	Péltophorxylon variegatum	Cassia fistula*	Indus to Arunachal in the east, in South Gujarat, Madhya Pradesh, Maharashtra, Deccan Karnatak, east and west coast and further to S i Lanka. Usually a deciduous tree ascending to 4000 ft. in Himalayas.
¹ 0.	Putranfivoxylon puratanum	Putranji va roxburghii*	Evergreen tree found along river banks throughout semi-tropical India.
11.	Ailanthoxy lon indicum	Ailanthus malabarica	Western Ghats and South Kanara
12.	Shoreoxylon krauseli	Shoréa talura and Shoréa tumbuggaia	Evergreen or moist deciduous forests of West Coast, Coorg, Tamil Nadu, Malabar, Mysore, North Arcot Cuddalore, Andhra Pradesh.
13.	Dryobalanoxylon	Dryobalanops, oblongifolia	Sumatra, Borneo and Malayan Peninsula.
14.	Barringtonioxylon	Barringtonia*	Coast of Tenassarium Tree with evergreen leaves, South Konkan.
15.	Careyoxylon pondicherriénsé	Careya arborea*	Throughout India in moist forests, also in Tamil Nadu and Kerala.

^{*} Species marked do exist in Maharashtra,

TABLE No. IX- E-26.2 .- contd.

Past Fossil species	Mode in Comparable species. Sonneratia apetala*	Littoral species of evergreen trees or shrubs of the Coromandel coast, Bombay etc.
16. Sonnératioxylon préapétala		
17. Parinarioxylon cuddalorense	Parinarium corymbosum	Malaysia
18. Alangioxylon scalari forme	Alangium javanicum and A. meyéri A. lamarkii*	Malaysia Belgaum hills.
19. Anogeissusoxylon indicum	Anogéissus latifolia	Throughout the dry forests in India from north to south; in Tamil Nadu, Eastern Coorg and Shimoga districts in Karnatak, South Kerala.

^{*}Species marked do exist in Maharashtra.

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27. QUATERNARY FLORA OF MAHARASHTRA

The first part of the Cenozoic era is Tertiary, and it lasted for about 60-70 million years. Of these, Palaeocene lasted 10 million years and Neocene 40 million years i. e. Miocene Oligocene, Pleiocene together occupied 40 million years. The second part of the Cenozoic era is the Quaternary period. The Pleistocene is the first part of it. It lasted for about one million years, followed by Sub-Recent and Recent which lasted for about 12,000 years, and then came the pre-historic period. Sub-Recent and Recent were short periods compared to Eocene or Mio-Pleistocene periods.

Tertiary flora of the Deccan Intertrappean Series belongs to Pleiocene. The Mio-Pleiocene flora lying above it is seen in Cuddalore Series in Tamil Nadu and in Tippam Series in Mizoram, but are not in Maharashtra. Miocene was essentially a hot dry period and long. It was succeeded by the moist, cold or arid cold climate of the Pleistocene. Climate changed several times. There were 3 or 4 glaciation periods. There is not much record of the Pleistocene flora in Maharashtra. However the Pleistocene period gave rise to old and new river alluvium. Below the new alluvium of rivers like Pravara, Adhala, Godavari and Wardha, there are calcarious shales impressed with leaves, but not as large deposits. The lateritic and regur soils are supposed to have been formed continuously, even at higher altitudes, by the process of sub-aerial action, and leaching of soils. They are all unfossiliferous. But in Sub-Recent times, in the vicinity of Sangamner below the river alluvium some leaf impressions are found at several places on calcarious shales.

There are also large tuffaceous deposits at Kotul on the banks of Mula river, and traverine caves. They were studied by Dr. D. R. Mahajan (1978) for fossil plants. He noted some flowering plants at Khanderaowadi, Mojalwadi, Nandur-Khandarmal etc. all in the vicinity of Sangamner in Ahmednagar district, and even a little peat at one place.

Plants found in travertine deposits at Kotul are mostly blue-green algae and diatoms. They are more like the present ones in fresh water. One Calcarious moss was also found. The fossil leaf shales at Sangamner on the bank of Pravara river, are overlain by archaeological deposits at Jorwe, Newasa and other places.

The list of plants seen on calcarious shales has among others Ficus arnottiana. This Ficus today grows in heavy rainfall regions like the ghats of Sahyadris. But at Khanderaowadi its fossil impressions are found deep in the lowest strata. A small lens-shaped cavity is also there. It is full of peat, about 150' long and 2" in vertical height. It seems a local development in a water trench or pot-hole. The peat contains pollen grains of some water plants and of Salix and Podocarpus Salix and Podocarpus do not grow here. Podocarpus has migrated south upto Tinevelly. Salix is still present on the river banks in stray strands at high altitude of Sahyadris. Other plants are Odina woodier and a Bambusa species. They occur in low dry hills and slopes. The former is a member of deciduous forests, and bamboos are found wild in moist or dry deciduous forests. Possibly in the Sub-Recent time they might have been growing under similar conditions, but due to progressive dessication of Deccan later, they started dwindling and disappeared.

The tuffaceous flora at Kotul has some fresh water Cyanophyceae, Diatomaceae, besides a Pottiaceous moss, Anoectangium strecheyaum Mitt. This tuffaceous bed appears to be later than the leaf-beds at

Sangamner. The leaf-bed is a continuous deposit after Pleistocene period, as it lies deep below the soil surface but above the heat pocket at the bottom of a local ditch.

The Quaternary Sub-Recent flora thus presents no different picture than that of the present day flora; only the species appear to have migrated or differently distributed. By further redistribution, and addition of new species from the surrounding regions, the present day flora of Maharashtra seems to have been formed.

In this connection, it is necessary to note that after the Quaternary Sub-Recent flora, not many changes have taken place in the geomorphology, geography and vegetation pattern in Deccan peninsula. India assumed its more or less present day form and position. after the late Miocene. Only a few changes took place in Maharashtra in Pleistocene. But in extra-Peninsular India tremendous changes took place due to tectonics and desiccation towards the end of Miocene period, such as rise of the Himalayas, changes in the river drainage systems, changes in the rain shade rainfall pattern, drying of Tethys, change in altitudes of mountains in North India etc. Rajasthan desert was formed filling the Indo-Ganga plain and the Rann of Kutch. Glaciation was also there. These are important events that markedly affected the plant, animal and human life in India. Man appeared on the scene in Pleiocene period after Miocene.

In Maharashtra tropical plants lingered in semi-evergreen pockets, and others migrated towards South India. The temperate species migrated to high altitude in Sahyadris, Baba Budhangiri and Nilgiris, and got locked up there. Many species disappeared from ghats and Desh due to uncertainty of rainfall and rise in temperature. The evolution of forests in Deccan was probably as suggested below by Mahabale (1978):—

(1) Evergreen-semi-evergreen-Moist deciduous-dry deciduous-thorn savannah-scrub-open grasslands in areas with less rainfall, poor soil or murum, or as a result of large drought period, mostly on the Desh side. Dr. Meher Homji (1976-78) of the French Institute, Pondicherry agrees with this view and has rightly pointed out that deciduous forests when degenerate due to paucity of soil, rain, humidity, adverse ratio of humid to dry period, ultimately develop into scrub on the Desh side. On the other hand when there is more rain and low temperature they again develop into moist deciduous forests or semi-evergreen forest. The past history of plants in Maharashtra thus, throws a good deal of light on various problems connected with the plant life and vegetation pattern in Maharashtra. The presence of open grasslands on the slopes of Sahyadris with pockets of relict evergreen or semi-evergreen forest is explicable on the above considerations. For example, in Miocene period onwards in the flora of Peninsular India, the genus Shorea was abundant, which was not so before. But subsequently Shorea robusta lost ground and Tectona grandis came forward as main component in the dry deciduous forests all over the Deccan Plateau.

There are other problems too, connected with the evolution and geographical distribution of certain genera in our flora. They can only be understood by looking to their past history and present day distribution, e.g., genus Terminalia. This genus has about 23 species in Indian flora, of which 13 species occur in Maharashtra and 6-7 in Madhya Pradesh Terminalia tomentosa is one of them. It was growing right

from Eocene times till today having the same anatomical structure of xylem in living as well as fossil specimens. It has not undergone any change obviously. It is a highly conservative species. Some other are lingering in Dev Raies and Ghats eg., Conarium and Musa superba in Ghats. But many have migrated to Cuddalore area in South India. Several genera of Maharashtra flora are found in fossil flora of Cuddalore (See lists below).

28. QUATERNARY TRAVERTINE FLORA OF KOTUL

[After Dr. T. S. Mahabale and D. R. Mahajan 1972, Geophytology, 2 (2): 175-177, and D. R. Mahajan 1976, Journ. Poona Univ. Sci. and Tech. 48: 32-42.]

Angiosperm Leaf impressions found near Sangamner (Dist. Ahmednagar).

1. Ficus glomerata Roxb:

Locality—Khanderaowadi. Leaf bed on the bank of Pravara river below alluvium 19 km to the East of Sangamner (Dist. Ahmednagar), Age-Sub-Recent.

2. Ficus arnottiana Mig:

Locality—Mojalwadi, 22.4 km East of Sangamner (District Ahmednagar).

Horizon and Age-Sub-Recent.

3. Odina woodier Roxb:

Locality—Mojalwadi, District Ahmednagar, in leaf bed-below, recent alluvium. Horizon-Late-Pleistocene; Age-Sub-Recent.

4. Tectona grandis Linn:

Locality—Nandur-Khandarmal (Ahmednagar) on the Pravara river bank below recent alluvium. Horizon-Late Pleistocene; Age-Sub-Recent.

5. Diospyros melanoxylon Linn:

Locality—Khanderaowadi (Ahmednagar) on the bank of Pravara river below alluvium. Horizon-Late Pleistocene; Age-Sub-Recent.

6. Leea Linn:

Locality—Nandur-Khandarmal (Ahmednagar), on the bank of Pravara river below alluvium. Horizon-Late Pleistocene; Age-Sub-Recent.

7. Zizyphus jujuba Lamk:

Locality—Khanderaowadi (Ahmednagar) below recent alluvium on Pravara river bank. Horizon-Late Pleistocene; Age-Sub-Recent.

8. Bambusa arundinacea Scherb:

Locality—Mojalwadi (Ahmednagar) in leaf-bed below recent alluvium on Pravara river bank.

Horizon—Late Pleistocene; Age-Sub-Recent.

9. Bridelia hamiltoniana Wall Cat:

Locality-Mojalwadi (Ahmednagar) on the bank of Pravara river below recent alluvium.

Horizon-Late Pleistocene; Age-Sub-Recent.

Travertine Algae and a moss in Travertine deposits at Kotul on Mula River bank, Dist. Ahmednagar [after Dr. D. R. Mahajan, 1978, Ph. D. thesis submitted to Poona University (unpublished).]

ALLGAE-

(a) Diatoms:

- 1. Cyclotella bodanica var. stellata Eulenstein.
- 2. Stephanodiscus niagarae Ehrenberg.
- 3. Fragilaria pinnata Ehrenberg.
- 4. Cocconeis placentula Ehrenberg.
- 5. Navicula rhynococephala Kuetzing.
- 6. Pinnularia major Smith.
- 7. Gomphonema olivaceum Kuetzing.
- 8. Cymbella affinis Kuetzing.
- 9. Cymbella cistula Grunow.
- 10. Cymbella lanceolata von Heurk.
- 11. Ephithemis turgida Kuetzing.
- 12. Rhopalodia gibba Mueller.
- 13. Surirella elegans Ehrenberg.
- 14. Navicula oblonga Kuetzing.

(b) Blue-Green Algae:

- 15. Chroococcus macrococcus Rabenh.
- 16. Chroococcus rufescens Nageli.
- 17. Chroococcus turgidus Nageli.
- 18. Lyngbya contorta Lemm.
- 19. Schizothrix calcicola Gomont.
- 20. Scytonema ocellatum Lyngbye.

(c) Moss:

1. Anoectangium stracheyanum Mitt.

All these algae are fresh water forms: the moss is a calcarious Pottiace-ous moss.

F. EPILOGUE

With completion of the consideration of the Quaternary fossil plants at Sangamner and Kotul, and other floras such as Archaeological plants, we reach the threshold of prehistoric plants that existed there for thousands of years back. They contain cultivated plants such as Hordeum vulgare, (अव), wheat, bajri, rice and a few wild or little cultivated plants like Zizyphus rugosa, Tamarindus Tindica, etc. Mostly their hard parts like grains and seeds are found. But in the Archaeological sites in Maharashtra no pollen grains have been detected. However they give us some idea of the early agriculture, people, plants and animals in this part of the country, but not the complete picture. Passing from the Archaeological flora we come to the study of present day flora which is an outcome of the past flora modified by changes in the climate and other factors, and the new arrivals from the surrounding areas. Vegetation

at no stage remains unchanged; and therefore, even the present one we considered here will also alter in course of time. The procession of plant life in successive times goes on and on, and it is for the botanists to view and study it, and modify if possible by adding new plants for the use of man.

G. HISTORY OF PLANT STUDIES WITH SPECIAL REFERENCE TO MAHARASHTRA

The earliest history of plants of this region is seen in the plants that enter into the frescoes, sculpture and paintings in caves at Nasik, Ellora, Ajantha, Aurangabad, Karle, and Gharapuri near Bombay. There are also several references in Sanskrit Puranas to the thick forests and vegetation at Panchavati, Tryambak and other places in Maharashtra. In the Sanskrit dramas like Uttarramacharitam or Mudrarakshas there are also references to forests abounding then in Maharashtra. In Prakrit literature of Hemchandra, there is occasional mention of the vegetation at different places. All these and archaeological data give a faint picture of the then existing plants, the people and crops in ancient Maharashtra.

Garcia Da Orta (1490-1570)]:

Garcia Da Orta was a surgeon with the army of the Portuguese East India Company and his duties required him to travel from Colombo to Surat. For a number of years he was staying at Goa, and was a keen student of the plants of Western India. He was acquainted with the indigenous system of Ayurvedic medicine and even included some drugs like Triphala into his practice. He had collected a number of plants and trees from the Western Ghats and had planted them in a big garden around his residence. He died at Goa in 1570. His greatest contribution to Indian Botany is his work on "Simple Drugs of India" which attracted attention of European physicians and pharmacists, as it was the only new work after famous work Materia Medica of Discorides in 1st century A. D. Garcia's work was translated into Latin and in a number of other European languages and got spread all over Europe. However, the Inquisition, which was all powerful in those days, forbade its use and circulation, the book being on Indian drug plants. Only a few copies of it were printed at Goa and one of the copies slipped out of India and a missionary called Reclusius, translated its summary in Latin and other languages and got it published at Antwerp. This work became as famous as the work of Discorides (1st century) on the properties of medicinal plants.

Van Rheede and Hortus Indicus Malabaricus (1678-1703):

Another important work on the botany of Western India is the grand monumental treatise published by the Dutch Military Commandant of Malabar, Heinric Van Rheede. This was published in twelve folio volumes at Amsterdam. It is a very fine piece of work with beautiful illustrations of plants of Western India published by the authority of the Dutch Government. It was written by three Ayurvedic physicians by name Ranga Bhatt, Appu Bhatt and Vinayaka Pandit. The last one probably was a Maharashtrian settled in Cochin. They had taken oath in the name of their family God for writing truthfully, only what they knew authentically to be true about the properties of plants. This oath by Vinayaka Pandit is in Marathi. It is probably, as Prof. S. P. Agharkar pointed out, the first published script in Marathi. Throughout this work, the local Marathi, Konkani names, as well as names in

Tulu, Malayalam, Kannada, Tamil and Arabic languages are given for the plants. The illustrations and descriptions are good. Many of them formed the basis of names for Indian plants by Linneus in Species Plantarum. Some of these names have come down to us in binomial form after they were published in famous "Hortus Indicus Malabaricus" (1678-1703). No important work thereafter has come to light on plants of Western India till nineteenth century.

Earlier there was a tradition of Botany as a descriptive science, but it died in the dark ages, and no account of its achievements is available. Ho wever, it lingered on in the books of Ayurveda, specially in those devoted to the study of plants as sources of medicines, called Nighantu. Many of these suffer from the defect that too many names have been given for the same species, or the same name is applied to different plants. This tradition of Nighantu continued till the end of the 13th century. By that time some European adventurers and travellers had come to India, and they wrote on whatever plants they observed. Amongst these two important persons whose names must be mentioned are Munichi and Jacquemont. The account of the plants collected by Jacquemont who was a charming Frenchman is available. Earlier Bermier (1653-1667) had visited India during Jehangir's time (1605-1627) and wrote about the plants of Kashmir he had observed. However, so far as the Western India and Maharashtra are concerned, Jacquemont's collections are important. They are described in a work called "Planteae Rariores Indiae Orientali Collectae A Jacquemont" published by his friend Cambessedes in 1848. They are now in Paris.

By that time studies on plants of Western India were started in the Grant Medical College, Bombay. Professors of Pharmacology used also to teach Botany. Some were well-known e.g. Dymock (1832-1892), Sakharam Arjun (1839-1883), and Kirtikar (1849-1917), Lisboa. Dymock's work on the Bazaar Medicines of Bombay, Western India, is still a useful book for the use of plant drugs in Bombay.

These were succeeded by the formal study of plants by Graham, Dalzell, Gibson, Woodrow, Gammie and Cooke. A brief account of them is given by Puri (1959) in his account of the Western Circle of Botanical Survey, Poona (Bull. Bot. Surv. India, Vol. 1 (1): 73-77). Pazi (1952) also has given an account of some of them in his paper on the Flora of Poona and neighbouring districts in *Poona Univ. Journal*, Science section 1 (2): 1-52. Quite a number of these persons were civilians or men in the Forest, Medical or Revenue service or in Judiciary. example, Birdwood was the Justice on the bench of High Court of Judicature at Bombay, Gibson was a Forester. Graham was Deputy Post Master at Bombay. However, the regular description of the plants of Western India was published by Dalzell and Gibson (1861) in their book "Bombay Flora". This was the first descriptive account of the plants of the then Bombay Presidency and was an improved version of the earlier list "Catalogue of Plants of Bombay and Vicinity" by John Graham (1839). Graham though a Deputy Post Master at Bombay used to make several trips to the Western Ghats and Khandala. The title of his book suggests that it is merely a list; it is not so. It gives a short account and sometimes diagnostic characters of the plants he had collected and described them. Unfortunately this extremely enthusiastic worker who must have visited Khandala Ghats several times even when there was no railway, died at a very young age of 34 at Khandala and lies buried in the cemetery very close to Saint Mary's Villa (now Police Training Headquarters), where his tomb is there. Locally it is

known as St. Xavier's Villa. G. M. Woodrow (1846-1911) was Professor of Botany at Science College at Pune and assistant to Dr. Cooke. He really built the herbarium of Western India. He published a paper (1895) on plants collected from Nagothana to Pune and other papers on Bombay flora in the Bombay Natural History Society's journal. In between a small book giving both popular and scientific description of plants of Western India was published in 1894 by the Rev. Nairne of the Bombay Civil Service (Ecclesiastical). He was stationed for a long time at Vengurla and Malvan; naturally his book contains reference to a large number of plants in Konkan region. Similarly, Gibson during his service was stationed at several places and travelled a lot. He was the Chief Conservator of Forests. He collected on a large scale plants of North Kanara and Belgaum, followed by Talbot who was also the Conservator of Forests for Bombay and Sindh. Talbot wrote his famous book with excellent illustrations "Trees, Shrubs and Climbers of Western · India" (1894). He also built large collections of plants from Sindh. All his collections are so beautifully mounted that even today they are a prized collection of plants of Western India in the herbarium of the Western Circle of the Botanical Survey of India at Pune. By far the most important book, The Flora of the Presidency of Bombay was written by Dr. Theodore Cooke, published after his retirement (1903-1908). He was the Principal of the then College of Science at Pune, now College of Engineering. His collections were taken to Kew from where he wrote at the instance of the Government of Bombay his well-known work "Flora of the Presidency of Bombay" between 1901 and 1908. The original set of plants including types at the Science College at Pune fell a prey to fire in that college, and was completely destroyed. However. Cooke had taken large collections with him to England from which, as he himself said, he had sent a complete set of plants (on which he wrote the three volumes of the said book) to the Science College for reference. This is now in the possession of the Western Circle of the Botanical Survey of India at Pune.

After these, studies on botany were vigorously carried out by different persons in the colleges where the studies on science were introduced after 1908. Members of the Jesuit Mission at Bombay, such as, Father Ethelbert Blatter, Hallberg, Caius, McCann all belonging to St. Xavier's College did marvellous work in Taxonomy, especially of Western India. Professor Hate of Wilson College, Dr. Kirtikar of the Indian Medical Service, Dr. Lisboa at Grant Medical College, not only made collections but also described them from time to time in the Journal of the Bombay Natural History Society. Kirtikar especially used to collect all kinds of plants and describe them. He was the first man to describe the fungi, liverworts and mosses of Bombay. Birdwood had collected plants of Matheran and Mahabaleshwar. Inspired by the tradition of these workers in Bombay a zealous worker of Junagarh, Jaykrishna Indraji Thakar described in Gujarati the complete Flora of Barda Dunger near Junagarh "Barda Dungarni Vanaspati" (1913) followed by another work "Kachhani Vanaspati Ane eni Upayogita" (Plants of Kutch and their uses). All these works are now a part of history and a great need is felt to bring them up-to-date both in point of collection and description.

A glance at the names of workers on the Botany of Western India including Maharashtra shows that it is really extraordinary that a number of non-botanist civilians, medical men and missionaries have materially added to our knowledge of plants. Several of them were not botanists in the formal sense, but were keen collectors with deep interest in plants

and development of Botany. They studied plants around them wherever they were stationed. Many of them are practically unknown now. It would be worthwhile recalling their memory here.

Dr. Alexander Gibson (1800-1807):

He first came to India as a vaccinator for Deccan and Khandesh. Because of his knowledge of plants he was appointed the Superintendent of the Botanical Garden of the East India Company at Dapodi near Pune, and was made later the first Conservator of Forests. He greatly added to the knowledge of the forest trees and forest practices, now followed all over India. He had intimate knowledge of villages and people and had a keen desire to improve their lives. He devoted the last few years of his service to the establishment of a well-known Forest Park and Botanical Garden at Hiwie in Junnar taluka in Pune district.

John Graham (1805-1839):

He came to Bombay in 1828. He was Deputy Post Master at Bombay and wrote his famous Catalogue of Bombay Plants (1839). He died at Khandala in 1839.

Joseph Nimmo (1819-1854):

He largely assisted Graham and completed his incomplete Catalogue of Bombay Plants, adding to it his own information. He was very generous in giving specimens to others. He was a friend of Wight, the author of 'Icones Plantarum'. He was probably born in India.

Nicol Alexander Dalzell (1817-1878):

He came to India in 1847 with a degree in Medicine, but worked in the Customs Department at Bombay. He used to collect plants during leisure. He was persuaded by Gibson to join him, initially on a very small job in Forest Department, but by dint of his knowledge and hard work he rose to be the Chief Conservator of Forests, Bombay. For a long time, he was staying at Thane. He was working under Gibson, and published the first annotated Flora of Bombay in 1861, largely based on the identification of Graham's Catalogue of Bombay Plants. It is a better and improved version of Graham's 'Catalogue'.

Dr. J. E. Stocks (1822-1854):

He was in the Bombay Medical Service, and being fond of plants, collected several species. Though he has not written formally, there are numerous references to his collections in Cooke's work. He largely collected in Sindh. He died prematurely. He supervised Victoria Gardens, Bombay, for some time.

Dr. William Gray (1886).

Civilian of Bombay Government. He wrote the Botany of the Bombay Presidency in Bombay Gaz. Vol. 25, Bombay.

Alexander K. Nairne:

There were other civilians like Johan Suderland Law (1818-1855) belonging to Medical or I. C. S. service who took keen interest in plant collection in the old Bombay State. References to their collections are made by Cooke at so many places in the 'Flora of the Bombay

Presidency'. Some members belonging to Ecclesiastical service were also quite keen collectors, especially the Rev. Bishop R. D. Ackland and Alexander K. Nairne. Nairne belonged to the Bombay Civil Service and was stationed at Vengurla, Malvan as a Missionary. The book he had written was for the use of common man and students for knowing plants in their environment viz. "The Flowering Plants of Western India" (1895). It is written in popular style with descriptions and diagnosis in brief.

Alexander Gammie:

He was also a non-botanist, mainly an agriculturist. He had a flare for collection of plants and took keen interest in the development of the Ganeshkhind Botanical Garden at Kirkee (Pune). He was for a number of years Professor of Agriculture in the Agricultural College at Pune. He was an Economic Botanist. He took part in Brahmaputra Expedition and plantation of cinchona trees at Mungupoo.

Birdwood brothers:

Herbert Mills Birdwood (1837-1907) was a Justice at the Bombay High Court and was very much interested in making collections at Khandala Ghat, Matheran and Mahabaleshwar. He prepared a "Catalogue of the Plants of Matheran and Mahabaleshwar" of which two editions came out before he went back to England in 1868. His elder brother Sir George Birdwood (1832-1912), was Professor of Materia Medica in Grant Medical College in Bombay. He has written 'Catalogue of Economic Products of Bombay.

George Marshall Woodrow (1846-1911):

He was a Professor of Botany at the Science College at Pune. He largely assisted Dr. Cooke in building the Poona herbarium which formed the basis of his flora and has written a book on the Gardening in Western India. He was helpful in building Agrihorticulturist Society's Garden at Pune (Empress Garden) and the Ganeshkhind Botanical Garden at Kirkee.

Alexander Talbot (1847-1917):

He was the Chief Conservator of Forests. He arrived in India in 1875. He made intensive collections in North Kanara and his collections were brought to the Science College, and are now in the herbarium of the Western Circle of Botanical Survey of India at Pune, and some at the herbarium of the Southern Circle of the Botanical Survey of India at Coimbatore. Like Sedgewick and Saxton's collections his collections are remarkable for the details which he noted and the way they were mounted, and preserved. He was not only interested in angiosperms but also in ferns. He wrote two books Forest Trees of Bombay, a small handbook and his well-known illustrated work "A Systematic List of the Trees Shrubs and Woody Climbers of the Bombay Presidency" (1894, 1909-1911). He had also made collections in Sindh and North Kanara.

Victor Jacquement (1801-1832):

He was a Frenchman. He came to Pondicherry and went to Calcutta to learn Indian Plants. He learnt to recognise plants and their names. He also learnt Urdu, Persian and Pushtu. He collected plants in Kashmir valley by a special permission of the Maharaja Ranjit

Singh. He was a good collector, daring traveller, full of vitality and vigour. After his hectic tour of Kashmir he returned to Delhi and reached Pune and thence Salsette, Bombay, where he died in December 1832. His collection went to Paris. The description of his plants is included in a work *Plantae rariorae Asiaticae* (1844). His collections contained several plants from Pune, Bombay, Ghats, besides those of Kashmir. A blue flowered creeper is named after him as *Jacquemontia violecea* Choisy which is a fitting memorial to this illustrious Frenchman.

Rev. S. Hislop (1818-63):

He came to India as a Scottish Protestant Presbyterian missionary and reached Nagpur in February 1845. The mission then used to run two educational institutes—Wilson College at Bombay and the Hislop College at Nagpur which was named after him. Though missionary by profession, he was deeply interested in Geology, Palaeontology and related subjects. While he was staying in mission's bungalow close to Takli near Nagpur, one day he came across a moluscan shell. He started searching animals an 1 plants at various places in the Intertrappean bed at Takli. His interest took him to other places from where he discovered many Tertiary intertrappean plants and plants of Glossopteris, Flora of Mesozoic period at Kamathi like Gangamopteris, Glossopteris Vertebraria, Noeggeriathiopsis. He had trained a field collector by name Vira who obtained a fruiting inflorescence looking like that of Mulberry (Morus) or of an aroid. Sahni named this after him as Viracarpon. When further specimens were obtained by J. K. Verma, he named it as Shuklanthus. A part of Hislop's collection went to his home town and a part of it is preserved in the British Natural History Museum at London. The latter was studied by Sahni. He will be rated next to Feistmantel in the field of Palaeobotany and the first one to focus attention on the Tertiary Intertrappean flora of Nagpur. He has written a small book on "Geology of Nagpur." His death by accident in a flooded nalla, with his horse took place at Bori in Bor Nalla near Nagpur on 4th September 1863. सन्धर्मव जयते

Theodore Cooke (1836-1910):

He came to India at the age of 26 in 1862 as an Engineer to build railways. He was not only a well-trained engineer but a geologist also. He had a great interest in Geology and Botany. He was a man of extraordinary ability and was soon made the Principal of Engineering College, Pune. He stayed for nearly 28 years in Pune and was well-known to public as a scholar and helpful citizen. He was very fond of collecting plants around Pune, Bombay, Ghats and nearby areas, but due to the difficulties of not having railway and good roads, he could not collect plants from Konkan area. For information about the plants in Konkan he relied on Nairne, Talbot and Dalzell. He had also trained and employed excellent plant collectors like Bhiva, whom he often quotes in his Flora of the Bombay Presidency. He was assisted by Professor of Botany, C. M. Woodrow, at the Science College (now Engineering College), Bhide, Ranade, Kanitkar, Bhagwat and others. It was he who built the first herbarium at Pune. Talbot, Young presented their collections to him. He wanted to train forest officers in Botany, but the Central Government did not agree to his proposal. In 1890 the Botanical Survey of India was constituted with Sir George King as its head. Cooke suggested to him that the regional floras should be published, as they will be helpful to people. King did not approve his suggestion but appointed him as the First Honorary Director of the Botanical Survey of Western

India, assisted by a few local plant collectors and a herbarium keeper. His total grant was less than Rs. 2,000 per annum for all this labour of love. In 1890, he retired from service and left Pune and went to England. In 1893, the Government of Bombay commissioned him to write the Flora of the Bombay Presidency. This was the first regional flora brought out in the country. For this purpose he moved to Kew where the collections of Gibson, Dalzell, Graham, Nimmo, Ritchie were housed. Till that time the only work on the flora of Bombay was the Catalogue of Bombay Plants by Graham, Dalzell and Gibson's Flora of Bombay and its vicinity and Nairne's Flowering Plants of Western India. he was working at Kew on the Bombay plants, an unfortunate thing happened. The whole collection comprising 1400 species and 5000 specimens were completely destroyed by fire in the Engineering College. While going to England, he had taken several sets of plants of Bombay Presidency with him and from his personal set he sent to Pune herbarium again a complete set of Bombay Plants. But as Puri (1959) has pointed out several of the types in it are not there. The herbarium now stands at a fairly high level having more than a lakh of herbarium specimens, The publication of Cooke's Flora continued from 1901 to 1908. It also contains the account of plants of Sind, Gujarat, Baroda, Sawantwadi and North Kanara. These, except Sawantwadi, are no longer parts of this State. In his account 2509 species with 147 varieties and 1003 general belonging to 147 families are described. Many later workers like G. B. Patwardhan, H. P. Paranjapye, S. R. Godbole, and W. Burns have added to them and the present number of collection is pretty high, over a lakh,

R. K. Bhide:

Among the early collectors, a special mention deserves to be made of R. K. Bhide who was herbarium assistant to the Professor of Botany, first at the College of Science and later College of Agriculture, Pune. His great mastery over the details of grasses was utilized by Blatter and McCann who wrote a large treatise on the Grasses of Bombay (1935), It is still a monumental work fully illustrated by R. K. Bhide.

सत्यमव जयत

Bhiva:

He was a plant collector of Dr. Cooke, trained by the latter. Numerous references to him in the Cooke's Flora of Bombay testify to the zeal, great interest and precision with which Bhiva made collections at a number of places.

Besides these, several other botanists like Dr. Sakharam Arjun Raut, Col. Dymock, Dr. Gadgil working in the pharmacology department of the Grant Medical College, Bombay, Professors Hate and Fzakiel of the Wilson College, R. N. Dastur, a well-known Plant Physiologist then at the Royal Institute of Science, Prof. J. T. R. d'Almeida and D. P. Mulla working at St. Xavier's College, B. S. Nawalkar, who worked on mangroves at the Royal Institute of Science, Bombay, all have contributed to the understanding of plants of Western India. Mr. Charles McCann had worked as the keeper of herbarium at the Prince of Wales Museum, and had voluminous collections of Bombay plants. In collaboration with Fr. Blatter he has published many contributions to the botany of Western India. He left India for New Zealand and was working at the National Museum at Wellington, New Zealand.

It is necessary to know further some very distinguished botanists of Western India.

Three noteworthy Indian associates of Van Rheede in writing Hortus Indicus Malabaricus:

They are Ranga Bhatt, Appu Bhatt and Vinayak Pandit. Van Rheede was the Dutch Military Commandant with the Governor of Malabar. He commissioned these three learned men in Ayurveda to write truthfully on the properties of drug-yielding and other plants, on oath of their family deity. They took the oath, each in his mother tongue printed in Hortus Indicus Malabaricus. They have given the description and illustrations and the local names of plants of Western India in their own languages and in script. The illustrations were drawn by artists and are quite good. Linnaeus, the great, had adopted their names as such in his binomial system of nomenclature in his "Species Plantarum" for Indian Plants. Their writings were translated into Latin and published by Van Rheede in Amsterdam between 1678-1703 in twelve large volumes. They are really the co-authors of this work and have made the Indian Plants famous all over Europe.

Dr. Celasio Dalgado:

He was a graduate in Medicine but was much attracted to Botany and Horticulture. He was employed in the service of the late Maharaja of Sawantwadi as the Civil Surgeon of the State. He started cultivation of cocoa and spices in Sawantwadi where the climate is suitable for them. He is the author of a useful book written in Portuguese, The Flora of Goa and Sawantwadi, published in 1898. He introduced a number of plants in that State from other parts of India, and especially from Sri Lanka. He died in Lisbon after 1898.

Colonel K. R. Kirtikar (1850-1917):

He belonged to the Indian Medical Service and saw active service in the Indo-Afghanisthan War (1880). He was Surgeon General with the Government of Bombay and is author of a number of articles on plants of Western India. He published them in the Bombay Natural History Society's Journal, in the development of which he took prominent part. His book on the 'Poisonous Plants of Bombay' is well-known. His other work with Dr. K. P. Basu, 'Medicinal Plants of India' is a fine reference work with illustrations (1918).

Dr. J. C. Lisboa (-1898):

Dr. Lisboa was Professor of Pharmacology in the Grant Medical College, Bombay. His interest was mainlyin grasses. His large collections of grasses are in the herbarium at the Grant Medical College, Bombay Natural History Society, and some in Blatter Herbarium, St. X'avier's College, Bombay. He has published articles on the grasses of Bombay. A prize in his name called 'Lisboa Prize' and a scholarship at the graduate level is awarded every alternate year by the University of Bombay for practical Systematic Botany.

Jaikrishna Indraji Thakar (1849-1930):

Jaikrishna Indraji was born at Lakpat in Saurashtra in October 1849. He served as the Curator of Forests and Parks in Porbander and as Treasury Officer till 1904, and after retirement was employed in Cutch State as the Superintendent of Palace Gardens at Bhuj. Being much interested in plants and research he collected plants of Barda Hills in Saurashtra and wrote a comprehensive account in Gujarati in a book entitled Kathiawadna Barda Dungarni Jadi Buti, Teni Pariksha ane Upayoga

(1910) (Botany and Comprehensive account of the Flora of Barda mountains, Kathiawar). He wrote another book in Gujarati Cutch Sansthanani Vanaspatio Ane Tene Upayogita (1926). These are the only books on flora, written in any Indian language. His earlier book on the Flora of Barda Mountains is now revised by Shri Bapalal Vaidya of Surat, published by Sastu Sahitya Vardhak Karyalaya, Ahmedabad.

His collection of plants is now kept in the herbarium of the Western Circle of Botanical Survey of India at Pune. He trained many Ayurvedic Physicians in the identification and classification of plants. His tradition was kept up by Gokuldas Bambdai who also has published a book on The Plant World of Kutch (in Gujarati) and by Shri Bapalal Vaidya whose several works on Indian Drug Plants in Hindi and Gujarati are wellknown.

W. J. Sedgewick:

He was an ICS Officer. He has made collections of grasses and added materially to the collection in the herbarium of the Western India. He is the co-author of a book called *Flora of Northern Gujarat* with W. T. Saxton, Professor of Botany at Gujarat College, Ahmedabad (1918). He got all his specimens identified and authenticated at Kew Herbarium. They are so nicely preserved that even today they are a model for the preparation of the herbarium sheets. They are in Botany Department, Gujarat College, Ahmedabad.

Rev. Father Ethalbert Blatter, S. J. (1877-1934):

Father Blatter was born in Switzerland on 15-12-1877 and joined the Society of Jesus in 1896. He came to St. Xavier's College, Bombay in 1903 as Professor of Biology and went back to Europe for studying various subjects. He returned to Bombay in 1915 and became the Principal of St. Xavier's College from 1921 till a few years before his death. He wrote several articles for the revision of Flora of Bombay and completed several of his works, such as Bombay Grasses. He knew several European languages and was adept in Western Music.

He trained many students in taxonomy and has written a very large number of papers, nearly 300. He was a great explorer of plants from Himalayas to High Wavy Mountains. He and J. F. R. Almeida have written a book on the Ferns of Bombay and a large treatise on the Palms of India and Ceylon (1926). He knew equally well Geology and Zoology and was fond of studying snakes. He was President of the Indian Botanical Society, Indian Science Congress and Bombay Natural History Society. He has contributed more than 200 papers in the Society's Journal.

He died at Pune on 26th May 1934. He was almost like an Encyclopaedia of Knowledge on plants, not only of Kashmir and Vaziristan and Western Ghats, but of the whole of India. He made intensive collections with detailed notes of their habitats and variations. His tradition was rightly kept up by his students like Professor S. P. Agharkar, D. L. Dixit, R. H. Dastur, M. A. Moghe, Charles McCann, J. F. R. d'Almeida and Father Santapau. All his collections are housed in Blatter Herbarium at St. Xavier's College, Bombay.

Prof. D. L. Dixit (1869-1948):

He was Professor of Botany at the Fergusson College. He started studies on the vascular cryptograms in Western India. He was a well trained systematic botanist and is the author of a small but extremely useful book Natural Orders of Angiosperms of Western India.

Prof. J. F. R. d'Almeida (1889-1949):

He was born at Bandra on 24-10-1889. He was a pet student of Father Blatter, and later Professor of Botany at St. Xavier's College, Bombay. He was a great master of systematic botany and anatomy and knew every plant in the vicinity of Bombay. He was also a good connoisseur of ferns and had worked on Indian *Ophioglossums*. He has published with Blatter a book on the Ferns of Bombay. In him, Botany and social service were combined in a unique way. He died at Bandra on 7th May 1949.

Prof. S. L. Ajrekar (1883-1954):

He was Professor of Mycology and Plant Pathology at the College of Agriculture, Pune. He started the School of Mycology not only in Pune but also in other places in the country. He was a distinguished student of the Wilson College, Bombay and had secured Mangaldas Nathubhai Scholarship for studying abroad on some applied branch of Botany. He went to Cambridge and studied mycology and plant pathology in the School of the most distinguished mycologist of England, Prof. Marshall Ward. He is the author of several articles on Botany in Marathi in Shrishtidnyan and Dnyankosh and has contributed several papers in English on the Fungi of Bombay. He trained a number of research students in the study of Mycology. He was Professor of Botany at the Royal Institute of Science, Bombay, and was required to go to Ahmedabad for organizing the newly started Botany Department at the Gujarat College, Ahmedabad, from where he retired in 1938.

Dr. W. Burns:

He was the Principal of the College of Agriculture, Pune and was a trained geneticist. He trained a number of young workers in the study of plant genetics at the College of Agriculture. He started the school of studies in ecology of grasslands in arid regions of India, especially around Pune.

Prof. R. H. Dastur:

He was the Professor of Botany at the Royal Institute of Science, Bombay, and later Plant Physiologist with the Central Cotton Committee. He was a well-known plant physiologist and has published a number of papers on the physiology of rice, cotton wilt, and on photosynthesis.

Prof. S. P. Agharkar (1884-1960):

Professor S. P. Agharkar was born at Malvan on 18th November 1884 Prof. Agharkar had matriculated from the Government High School, Dharwar. He knew Kannada well. He took his B. A. degree in First Class from Elphinstone College, Bombay in 1902 with Botany, Geology and Zoology as optional subjects. He was awarded Bell prize for proficiency in English at B. A. He got Lisboa Scholarship for Practical Botany in 1907. He took his M. A. degree in Biological Sciences in 1909 and started teaching at Elphinstone College. Under the influence of Father Blatter he developed 1 cen interest in plant and animal exploration and collection, and explored the Western Ghats. He got a fresh water medusa at Tambi in Koyna, Venna and Krishna rivers later named Limnocnida indica by Annandale. This caught the attention of Sir Wright W. Smith, F. R. S., Superintendent of the Royal Botanical

Garden, Calcutta. At the suggestion of Sir C. V. Raman he was appointed by Sir Ashutosh Mukerjee to the Chair of Ghosh Professor of Botany. To obtain advanced knowledge in Taxonomy of plants he went to Germany on 2nd May 1914, but I World War soon broke out, and as an enemy subject he was interned in various German Camps from October 1914 to June 1917. Even during internment he used to collect and study plants. After the cessation of hostilities he was privileged to study botany in Berlin under the distinguished German Professors Engler, Diels, Pilger, Lindau and several others. At the end of two years he presented a thesis entitled Verbreitungsmittel der xerophyten und sub-xerophyten des Nordwestlichen Indiens und ihr Herkunft, which was considered "very laudable" by Engler and Heberlandt. After getting the Ph. D. degree he visited a number of countries in Europe and returned to India and, started teaching Systematic Botany, Plant Geography, Gymnosperms, and Genetics at Calcutta University. He explored the flora of Nepal. He organized the Botany Department of Calcutta University on a large scale, where several disciplines were equally well-developed. His interest was varied, in Angiosperms, Water plants, Bengal plants, origin and composition of plants in Indian desert etc. By dint of his devotion, integrity and hard work he became the Secretary and Treasurer of several bodies such as Indian Botanical Society, Royal Asiatic Society of Bengal. National Institute of Sciences of India and a member of several committees appointed by the Government. A special mention must be made of his appointment as Chairman of the National Herbarium Committee which ultimately resulted in the revival of the Botanical Survey of India in 1950. All these numerous extramural activities made large inroads on his time and energy. On 7th October 1944, with Dr. M. R. Jayakar, Principal Gharpure of Law College, Pune and fellow botanists like Professor S. L. Airekar, and N. V. Joshi he started the Maharashtra Association for the Cultivation of Science. This has now developed into a first class research institute. Afterwards he developed cancer and was operated for it in August 1956 and succumbed to the disease on 2nd September 1960 nearly after five years of operation. His inaugural contribution in German for Ph. D. degree on to the arid and semi-arid plants of North Western Frontier Province and their means of dispersal is a very valuable paper. His account of History of Botany in 1938 is famous. His work on Medicinal Plants, Timbers and Miscellaneous Plants published in three volumes of the Gazetteer of Bombay State, published by the Gazetteers Department are a spectacular contribution to knowledge.

Father H. Santapau (1903-1970):

Dr. H. Santapau, Professor of Botany at the St. Xavier's College, Bombay was born in Spain on 5th December 1903. Prior to his joining St. Xavier's College he had studied at Rome and London from where he got his doctorate on the Flora of Khandala. For this he had examined all the plant material of the Bombay Presidency at Kew Herbarium. He joined the Botanical Survey of India as its Director and reorganised the work of the Survey. He got reprinted the regional floras of various He also reorganised the Indian National Herbarium at Calcutta and Botany section of the Indian Museum, Calcutta. He did a yeoman's service to the cause of systematic botany of Western India and the whole of India. He led a team of botanists to tour and to collect material in U. S. S. R. in 1962. Though Spanish by birth he had accepted Indian citizenship. He died at Bombay on 13th January 1970. He has published numerous papers on the taxonomy of Indian Plants, but he is very well-known for his books "Flora of Khandala" and "Flora of Purandar" They are a model for workers in taxonomy.

H. P. Paranjapye (1879-1977):

He was born at Murdi near Anjarle in Ratnagiri. He graduated in Natural Sciences in 1905 from Fergusson College, Pune and worked in the herbarium of the Economic Botanist at the College of Agriculture under famous British botanists like Dr. Gammie, Dr. Harold Mann, Dr. Burns etc. He tried to conserve rare botanical plants planted by early British botanists at Ganeshkhind Botanical Garden, Pune, and re-arranged the whole botanical garden. He conserved some mango trees that were planted in the days of Peshwas. His book in Mara hi (आमनी फठबार) is very popular and has run into three editions. After the first World War he was sent to Mesopotaemia to bring new varieties of citrus, grapes and figs. Soon after he was made the Chief of the Ganeshkhind Botanical Garden and Professor of Economic, Botany and Horticulture at the College of Agriculture, Pune. He has written a number of articles on farming. He was the Secretary of Maharashtra Association for the Cultivation of Science for a number of years.

Madhav Narayan Kamat (1897 -1980):

Prof. Madhav Narayan Kamat was one of the most distinguished Mycologists and Plant Pathologists of India. Born at Ubhadanda in Ratnagiri district on 5-5-1897, he was educated at Kumata in North Kanara district, and at College of Agriculture, Pune. He graduated in 1919 from that College and took M.Sc. degree working under Prof. Stakman at Minnesota University in U.S.A. in 1932, and joined the College of Agriculture, Pune as Assistant Professor of Mycology and Plant Pathology. Here he taught and worked for 30 years and was in charge of various schemes dealing with genesis and control of Kole Roga of betel-nut, Mildew of betel vine, Gummosis of citrus, Corn Rust of jowar, and various other plant diseases.

By vast experience, he was almost like a Dictionary of Mycology and Plant Pathology. He has published 350 research papers and guided research work of 30 students. With Prof. S. P. Agharkar and Prof. S. L. Ajrekar, he was instrumental in building the Maharashtra Association for the Cultivation of Science at Pune. In view of his contribution and books on the subject, the Mahatma Phule Krishi Vidyapeeth (Agricultural University) at Rahuri awarded him D.Sc. Degree. He was elected President of the All India Phytopathological Society in 1975. After a short illness he expired at Pune on 3rd December 1980.

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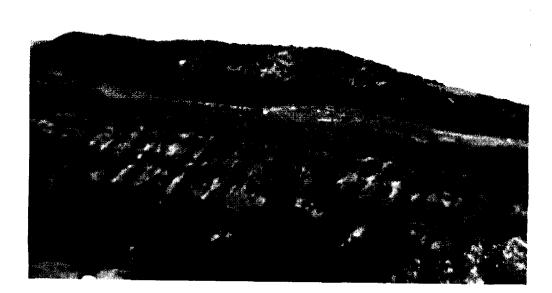
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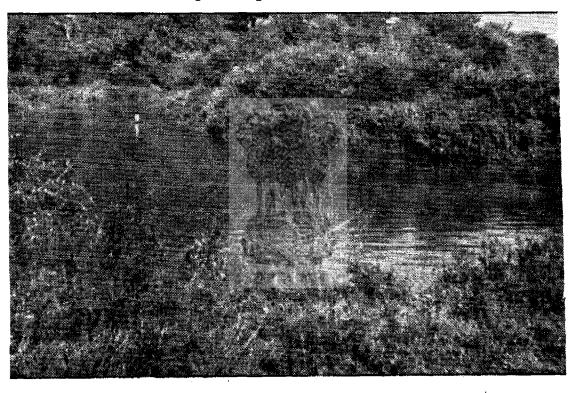
Mahabaleshwar Ghat



सन्यमेव जयते



Mangroves Vegetation at Mumbra

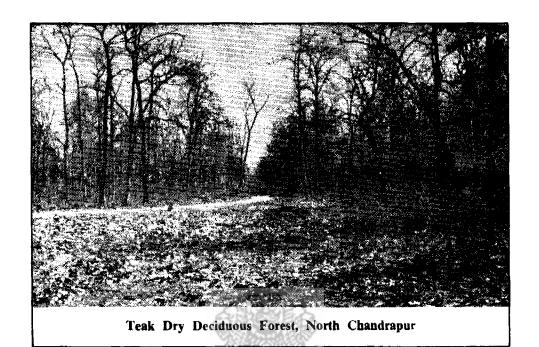


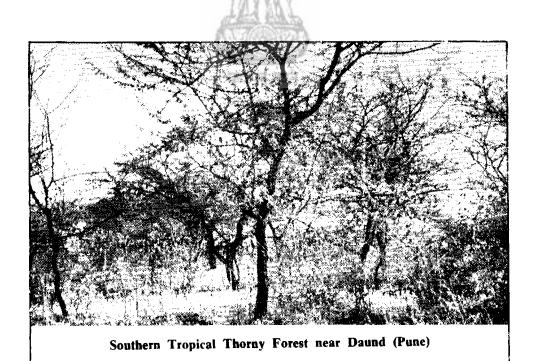


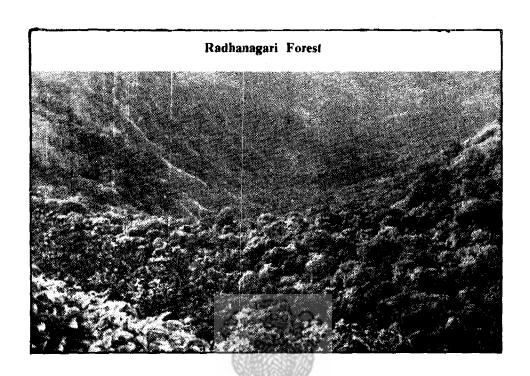
Swampy Mangroves Vegetation near Thane Creek

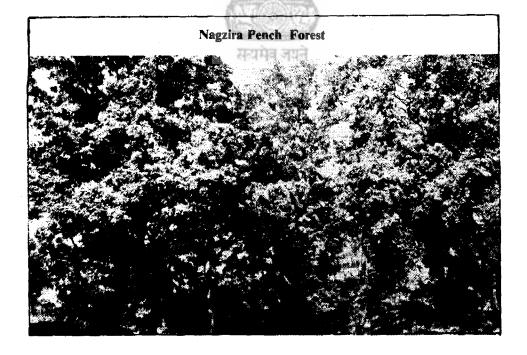


Evergreen Forest, Radhanagari

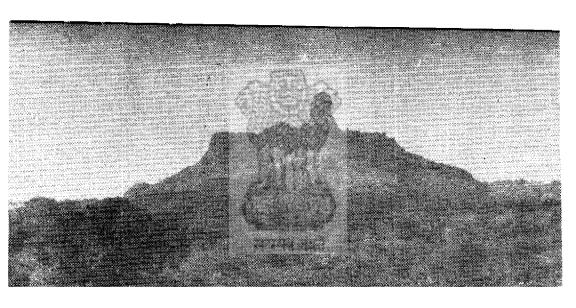




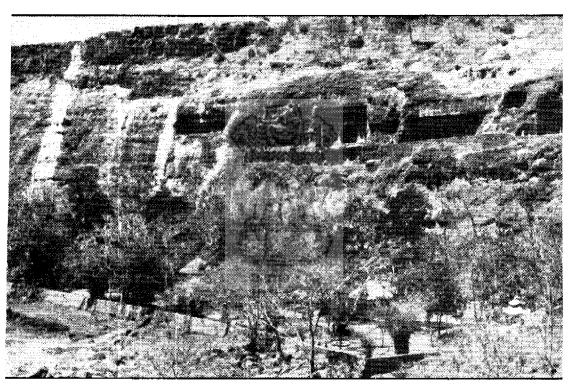




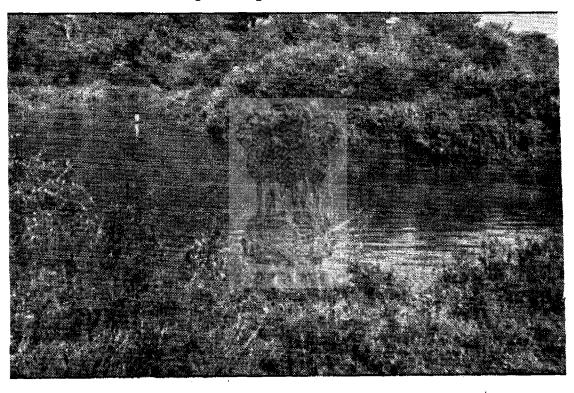
Karnala Forest

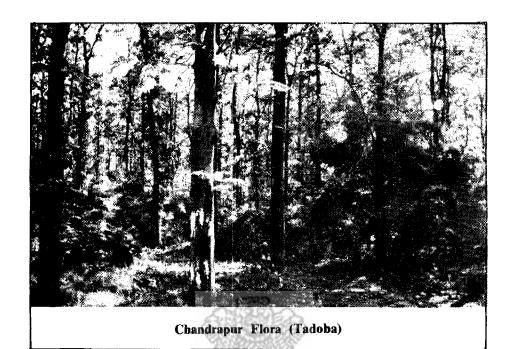


Flora around Ajantha Caves

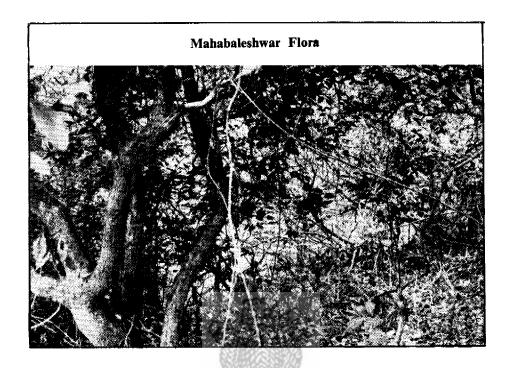


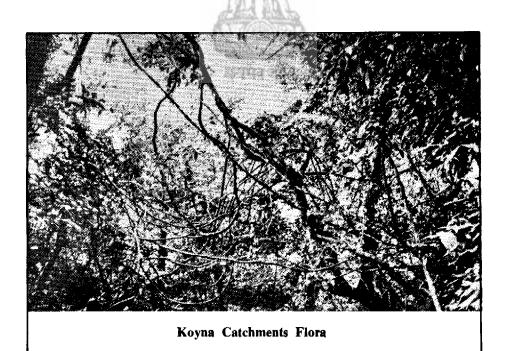
Mangroves Vegetation at Mumbra













Orchid Epiphytic



Root Parasite